

Combustion In Pre-Industrial English Literature

Prof. Dr J. Clifford Jones



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Clifford Jones

Combustion In Pre-Industrial English Literature

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1st edition

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Preface

During a period of sick leave from the University of Aberdeen in 2012 I wrote 'The Sherlock Holmes Stories and Combustion Science'. It did reasonably well in terms of reviews. This book is on a grander scale altogether, and I was conscious when I started it of a major disadvantage: whereas by the time I started the book on the Sherlock Holmes stories I was familiar with all of them – I had been a Sherlock Holmes enthusiast for decades – I am not acquainted at more than layman's level, if that, with the authors who feature in this book, the scope of which extends across eight centuries. Counterbalancing this were two factors: ready availability of the works I planned to cover by electronic means, and an interest in the history of fuels and energy which, even before the Sherlock Holmes tome, led to a few publications by way of articles and commentaries. Anyway I decided to have a go and this book is the result. Numerous times when preparing the book I have noted an account of matters relevant to fuels and combustion which had clearly been closely observed centuries ago which can now be interpreted on the basis of modern ideas. This has perhaps been my greatest satisfaction in the writing of the book and might I hope be an appealing feature to potential readers.

Inevitably there are some authors who feature centrally in this book, including William Shakespeare himself. There are several others of whom I had never heard before I started the book, and references to their work are not as extensive. I see this as inevitable, and representative of the contributions of the respective authors who, as noted, range enormously in period. The electronic sources of the books referred to sometimes, in the case of the earlier works drawn on, differed from the originals through modernisation of the English. I did not see that as important for the purpose of this book: if for example fire is spelt 'fyre' in the original that does not make my work as an exegete more difficult (quite the opposite!) or, more importantly, the inferences less sound. This is especially so of the earlier works covered, notably those of Chaucer, where the 'interlinear' versions of his work where accessible have been of great help.

'Industrialisation' is usually considered to have begun in about 1760, although it is not as clear-cut as that. One point which emerges in this book is that ingenuity was applied to operations in times long before movement of the population to centres of manufacturing. Even so, consistently with the usual definition no author features in this book who was born later than the 1770s. (It is to the author's regret that this upper limit of date of birth precludes inclusion of Shelley, who was born in 1792, and of Byron, who was born in 1788.) The matter concerning the 'timeline' applies especially to the issue of coal production and utilisation where any historical demarcation between pre- and post-industrial is very indistinct.

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Any reader wanting to contact me should not hesitate to do so.

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Dedication

Professor Goonasagree Naidoo
in gratitude for times shared with the author in the UK and in South Africa.

1 Wace (approx. 1100–1174)



Work cited	Quotations
<p>Roman de Brut (written 1155). Translation by E. Mason, drawn on in the next column, accessible on: http://www.gutenberg.org/cache/epub/10472/pg10472-images.html</p>	<p><i>Over against the mount was set another hill, near by, and of lesser height, and upon this hill also a fire of coals.</i></p> <p><i>When this was done they flung wild fire from their engines upon the castle. The fire laid hold upon the castle, it spread to the tower, and to all the houses that stood about. The castle flared like a torch; the flames leaped in the sky; the houses tumbled to the ground.</i></p> <p>Many other references to the burning of buildings in Roman de Brut.</p>

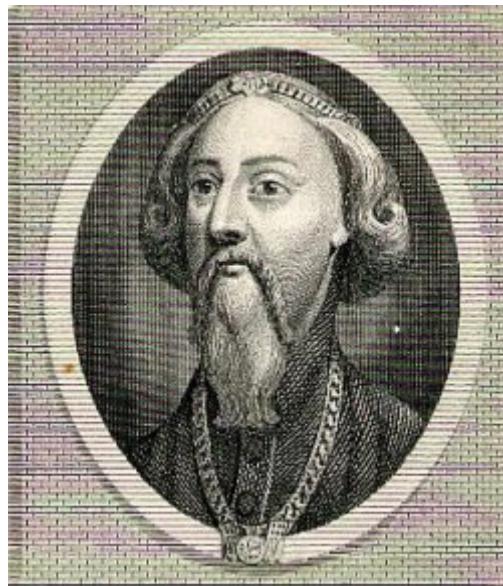
One has to date the reference to coals as being somewhere close to the reign of King Arthur, 5th and 6th Centuries A.D. following the collapse of the Roman Empire. The point will be made later in the book that in Roman England coal was in use, and was possibly even exported. That makes appearance of coal in the quotation from Wace quite natural. The coal produced at that time and much later was outcropping coal, that is, coal at or above the level of the soil structure accessible by simple digging. Nettlebridge in Somerset is believed to have been the scene of coal mining in this fashion in c. AD 50 [1]. In other parts of England coal ash has been found in archaeological investigation of Roman sites.

The word 'engine' in the second quotation stems from the fact that the word is etymologically identified with 'ingenuity' and by the translator has been applied to anything of human invention or devising: the word occurs several times in the translation drawn on. Castles in the Arthurian period were composed mainly of wood, so those setting fire to one did so with ease. One wonders whether conditions were windy when the castle was burnt: that would help explain the very vigorous combustion behaviour described.

Reference

[1] <http://list.historicengland.org.uk/resultsingle.aspx?uid=1019022>

2 John Gower (1330–1408)



Work cited	Quotations
<p>Confessio Amantis (completed c. 1390). Translation by Richard Brodie drawn on in the next column. Translation accessible on: http://www.richardbrodie.com/Book1.html</p>	<p>From Book 4: <i>In hopes that he, on his returning, Would espy the lantern burning</i></p> <p><i>Where night and daytime intersect: There is no candle burning</i></p> <p>From Book 7: <i>And finally there's just one more; The element that's number four Is fire; since far afield it's found The other three does it surround, And dry is it, of moisture free.</i></p> <p>From Book 8: <i>A piece of wood that's set on fire, Will soon assume an ashen mode;</i></p> <p>Very many other references to 'burning' and 'fire' in 'Confessio Amantis' which are too figurative for a scientific exegesis.</p>

At the time Gower is writing some 'lanterns' had a ceramic outer structure [1]. It is noted in [2] that in the 14th Century candles were made from tallow which was not available in abundance and had to be used sparingly in making candles. Maybe that is why at the 'intersection' between night and day candles were extinguished; they'd obviously last longer that way. The quotation from Book 7 is an obvious reference to the four-element idea of Aristotle, who is referred to several times in Book 7. The inter-relatedness of the 'four elements' – earth, air, fire and water – is now known but could not have been more than intuition in Gower's day. (Such intuition is suggested by 'The other three does it surround?') Where do coal, oil, natural gas, peat and shale come from if not 'earth' if that term means the non-marine core of our planet¹. 'Air' is needed to burn any one of the fuels referred to and 'water' is a reaction product. But that such thoughts could possibly have occupied the minds of Gower and his contemporaries is inconceivable and any man or woman is restricted to the mindset of his or her times (although it is the privilege of the few to modify it). The quotation from Book 8 reflects that the destructive potential of fire has been observed with awe by persons in every age and generation.

References

[1] <http://www.larsdatter.com/lanterns.htm>

[2] <http://www.valleyadvocate.com/2011/12/16/the-not-so-dark-age-light-in-14th-century-britain/>

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3 Geoffrey Chaucer (1343–1400)



Work cited	Quotations
<p>The Knight's Tale.</p> <p>Accessible on: http://www.online-literature.com/chaucer/canterbury/2/</p>	<p><i>With fire in hand, as use was, to ignite The sacrifice and set the pyre alight...</i></p> <p><i>But how the pyre was maked up on height, And eke the names how the trees hight, As oak, fir, birch, asp, alder, holm, poplere, aspen Willow, elm, plane, ash, box, chestnut, lind, laurere, linden, lime Maple, thorn, beech, hazel, yew, whipul tree...</i></p> <p><i>Emily, as was the guise, Put in the fire of funeral service...</i></p> <p>Description of the pyre at the funeral of the young knight Arcite.</p>
<p>The Canon's Yeoman's Tale.</p> <p>Accessible on: http://genius.com/Geoffrey-chaucer-the-canterbury-tales-the-canons-yeomans-tale-annotated</p>	<p><i>Our lampes burning bothe night and day, To bring about our craft if that we may; Our furnace eke of calcination, And of waters albification...</i></p> <p><i>And divers fires made of wood and coal...</i></p> <p>'Our craft' is alchemy (= philosophie in the poem).</p>
<p>The Wife of Bath's Tale (Prologue).</p> <p>Accessible on: http://www.librarius.com/canttran/wifetale/wifetale083-100.htm</p>	<p><i>For peril is bothe fyr and tow t'assemble...</i></p> <p>'Tow' still means a type of fibre such as might be used in upholstery (see main text).</p>
<p>The Merchant's Tale.</p> <p>Accessible on: http://www.poetryintranslation.com/PITBR/English/CanterburyTalesIX.htm</p>	<p><i>O perilous fire, that in the bed-straw gathers!</i></p> <p>Cereals, yielding straw as a by-product, produced in large amounts in Kent at the time of the Tales. Nearby markets for the cereals, which included barley, in London and on the continent [6].</p>
<p>The Parliament of Fowls. (Precise date of writing uncertain. Not one of the Canterbury Tales.)</p> <p>Accessible on: http://www.poetryintranslation.com/PITBR/English/Fowls.htm</p>	<p><i>Cytherea, you blissful lady sweet Whose firebrand at your wish robs us of rest...</i></p> <p>Several other references to fire in the poem.</p>

<p>Tale of Melibee (a Canterbury tale, written c. 1385).</p> <p>Accessible on: https://sites.fas.harvard.edu/~chaucer/teachslf/mel-par.htm</p>	<p><i>fyr hath longe tyme endured, that ther ne dwelleth som vapour of warmnesse.</i></p>
<p>'The Man of Law's Tale' (Prologue).</p> <p>Accessible on: https://sites.fas.harvard.edu/~chaucer/teachslf/mlt-par.htm</p>	<p><i>In faith, you say, at some point he shall pay for it, when his carcass burns in the coals, because he did not help the needy in their need.</i></p>

'The Knight's Tale' (row one) was of course one of the Canterbury Tales. Like Shakespeare, Chaucer often drew on recorded ideas from long before his own time and 'The Knight's Tale' is said to draw on the 6th Century philosopher Boethius [1]. Such detail is given to the composition of the funeral pyre. Emily, in 'putting in the fire' was igniting the pyre. A little science can be infused into Chaucer's narrative. The choice of wood for the pyre influenced the fragrance, seen as symbolic in affirming the worthiness of the deceased whilst committing him or her to eternity. It has its counterpart in the still prevalent practice of burning incense at a requiem. It is said to take 600 to 880 kg of wood to incinerate a human body, information based on much more recent use of the practice in Hindu cultures [2]. Modern cremation practices require of the order of 50 cubic metres of natural gas to destroy a human body [3]. The calorific value of natural gas is, depending on the precise composition, $\approx 37 \text{ MJ m}^{-3}$ so the amount of heat per body is:

$$50 \times 37 \text{ MJ} = 1850 \text{ MJ (1.85 GJ).}$$

For a funeral pyre, taking the mid range of the quantity of wood and using a value of 15 MJ kg^{-1} for the calorific value (a value indicating wood not quite seasoned), the amount of heat released on burning the pyre would be:

$$740 \times 15 \text{ MJ} = 11100 \text{ MJ (11.1 GJ)}$$

and there is a difference of half an order of magnitude. This is not all that surprising, and the need for 'fragrance' provides a clue. Aromas are created by breakdown products including tars in the wood, and if wood combustion was complete these would be burnt instead of being released as fragrances. The fact that wood combustion is highly *incomplete* in a funeral pyre is evidenced by the calculation above. There would be no fragrancing effect if the wood burnt all the way to carbon dioxide and water, each of which is of course odourless. The fact that so many types of wood were blended suggests that it was known from experience and trial which combination performs best as a fragrancing agent. This is entirely analogous to the blending of tobaccos to give popular flavours. (There is a return to wood fragrance in the section of the book on Shakespeare when 'Taming of the Shrew' is considered.)

Incomplete combustion in a pyre indicates that part of it was burning not by flaming but by smouldering². The latter is about an order of magnitude slower in propagation than the former. Even in flaming combustion of wood temperatures are much lower than in cremation with natural gas, about 700°C and 1500°C respectively.

Canon's Yeoman's Tale (two individuals, the Canon and the yeoman) is also one of the Canterbury Tales. Use of coal in the practice of alchemy is clear: later in the tale the plural is spelt 'coles'. The basis of alchemy as recounted in the tale was the belief that a base metal such as lead in the ground would over time become a precious metal such as gold, and that the transition could be accelerated by extracting the base metal and heating it. This provides an interesting point of contact between organic minerals (coal) and inorganic ones (metal ores). Poorer (lower rank, in formal terminology) coal in the ground does over time of the order of millions of years become better coal ('higher rank'). If lower rank coal is extracted and heated it forms a char which in some respects, most importantly carbon content, resembles higher rank coals. This in a sense is consistent with 'alchemy' so understood, but it has no analogue in the processing of metal ores nor would a fuel technologist refer to it as alchemy except perhaps in humour.

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A modern translation of the utterance of the Wife of Bath (next row) is ‘For it is perilous to assemble both fire and flax’ [4]. ‘Tow’ (rhymes with ‘cow’) has a more general meaning now than in Chaucer’s time, though then as now it meant a bundle of fibres. Linen made from flax was imported into England in Chaucer’s time from places including Brittany [5]. That the Wife of Bath chose this as an example of an ignitable material is not at all surprising.

Straw bedding (following row), still used in places such as stables, is noted in writings very much more recent than Chaucer’s as being an extreme fire hazard: ‘Fire is the greatest danger to a stabled horse.... A fire in straw bedding can burn more than a ten foot circle in less than three minutes’ [6]. Straw is cellulosic like cotton and ignites readily through its high reactivity. Once straw bedding is ignited combustion propagates rapidly because of the low bulk density as compared, for example, to a solid block of wood or a compressed bale of straw. In the terminology of combustion science, straw bedding has a low thermal inertia or is thermally thin. So the figure of speech in ‘The Merchant’s Tale’ is one to which hearers could readily have related³.

Use of ‘firebrand’ in ‘The Parliament of Fowls’ is consistent with the view that that expression in its strict sense to mean a piece of wood on fire, a potential deliberate or accidental ignition source, came into use in c. 1200 [8]. It is also recorded in [7] that the term in its sense of ‘one who kindles mischief or passions’ dates from the late 14th Century. Quite possibly Chaucer was instrumental in that.

In the quotation from ‘Tale of Melibee’ the expression ‘som vapour of warmnesse’ is an interesting one to the present-day practitioner in thermal sciences. It would be expressed by him or her as ‘remaining heat’, heat not yet having been lost by transfer to the environment. A trained engineer would distinguish it from, for example, the heat detectable when a car engine is switched off. That is chemical energy from the fuel converted to heat instead (as would have been preferred) to mechanical work. The ‘vapour of warmnesse’ arose from an operation in which entire conversion of chemical energy to heat was the intention. In the following row, use of coal as a fuel in cremation is referred to. That this was so in addition to wood for such a purpose is not surprising, as it was done in Roman times! Coke was so used during the Holocaust against the Jewish people in the 1940s.

References

- [1] <https://www.sfsu.edu/~medieval/Volume%201/Camarda.html>
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- [3] <http://cremationorburial.org/energy-use/>
- [4] <https://notometolose.wordpress.com/2013/07/07/the-man-of-law-epilogue-the-wife-of-bath-pt-1/>
- [5] Postan M.M. ‘Mediaeval Trade and Finance’ Cambridge University Press (2002).
- [6] Smith Thomas H. ‘Care and Management of Horses’ Eclipse Press (2004)
- [7] <http://www.etymonline.com/index.php?term=firebrand>

4 Thomas Malory (1405–1471)



Work cited	Quotations
Le Morte d'Arthur Chapter XXXVIII Accessible on: http://www.gutenberg.org/ files/1252/1252-h/1252-h. htm#link2HCH0238	<p><i>...and then will he come and set wild-fire on every part of the castle, and I shall get you out at a privy postern, and there shall ye have your horse and your harness.</i></p> <p><i>...thither came the Earl of Pase with four hundred knights, and set on fire all the parts of the castle, that or they ceased they left not a stone standing.</i></p>
<i>Ibid.</i> Chapter XXXII. Accessible on: http://www.sacred-texts.com/ neu/mart/mart269.htm	<p><i>And or it were day he let put wildfire in three of his own ships, and suddenly he pulled up the sail, and with the wind he made those ships to be driven among the navy of the Saracens. And to make short tale, those three ships set on fire all the ships, that none were saved.</i></p>

The term wildfire (no hyphen in modern usage) has become a cliché in the present time ('spread like wildfire')⁴ and can be taken to mean accelerated fire. Nowadays a fire can be accelerated by use of a substance such as kerosene, common in the practice of arson. What did the term mean in Malory's time? Coal tar pitch was used in weaponry by Malory's time and indeed well before it. Its lightest components can be used in deliberate destruction by fire, and can be soaked up by wood to make an incendiary device as in fact happened at the Siege of Berwick in 1333 [1]. This would probably have been within oral tradition in Malory's own time. So it is fairly clear what inspired Malory here. The inventors of napalm in the 1940s really went only one step beyond what had been the practice for numerous centuries: the gelatinised the flammable substances (in the case of napalm, *napththalenic acid* and *palmitic acid*). The term wildfire appears in the next quotation from Morte d'Arthur which is concerned with fire in shipping. The ships would have been made of timber and waterproofed with wood tar, so in intentional burning there was already an accelerant present.

References

[1] <http://skylander.orgfree.com/halidon.html>

5 Stephen Hawes (c. 1474–1521)

Work cited	Quotations
<p>The Pastime of Pleasure (published 1509).</p> <p>Accessible on: http://www.gutenberg.org/files/34840/34840-h/34840-h.htm</p>	<p><i>...because it is impossible but that the fire, although it be raked vnder the ashes, must giue some heat</i></p> <p><i>... which fire hath so fiercely inflamed all the most sensible parts of my body,</i></p> <p><i>When they were come to the Castle, and dismounted from their Horsses, many Welcomes and Gratulations were made to the knight, which yelded more wood to the fire.</i></p> <p><i>...all that which she thought vpon in the night, vanished so sone as the flame of burned Straw..</i></p> <p><i>...but the fyre must flame abroade</i></p>

The first of the statements concerning 'The Pastime of Pleasure' relates to re-development of combustion after attempted extinction, an occurrence of which a present-day fire protection expert needs to have an awareness. The second is relevant to the concept of 'sensible heat' which has featured so many times in this volume, and the third a reflection of the use of wood as a staple fuel at the period. The fourth is a statement of the rapidity of straw combustion. To the fire expert apt to view such things in a prosaic way, the fourth statement means simply that ignition is always followed by propagation. This is probably what was meant by Hawes even if the setting of the statement was poetic.

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6 Richard Tottel (1530–1594)



Work cited	Quotations
<p>Tottel's Miscellany a.k.a. Songes and Sonnettes (published 1557).</p> <p>Accessible on. https://archive.org/stream/tottel miscella 00arbegoog/tottel miscella 00arbegoog_djvu.txt</p>	<p><i>And now, the coales I follow, that be quent, From Doner to Calais, with willing minde.</i></p> <p><i>As was the fyre made on the fea By Naulus hate fo odious.</i></p> <p><i>How might I do to get a grafte: Of this vnfpected tree.</i></p> <p>The work is an anthology of poems.</p>

The first quotation is a simple statement of the fact that coal was in the 16th Century exported from England to France. It can however be put more emphatically than that. There was a saying in the middle of the 16th Century that 'France could no more live without coals from Newcastle than could a fish without water' [1]. The second quotation clearly has its basis in mythology, in some ways less interesting to the author of a book like this one than the straight commercial history of the first quotation. The third quotation is one of many involving 'trees' in the work. 'Tottel's Miscellany' was written at a time when (as noted elsewhere in the present book) the depletion of forests to provide wood fuel was becoming an issue of some urgency and use of coal was starting to alleviate it. An impression impossible to convey with arbitrarily selected quotations from a very lengthy anthology, but which comes across on a perusal of the whole of it, is that writers were conscious of this wood-coal balance of the period. It is intensely reminiscent of the present time, with its preoccupation with replacing felled trees, that a graft of a tree for 'potting' was desired.

References

[1] Zins H. 'England and the Baltic in the Elizabethan Era' Manchester University Press (1972).

7 Thomas Sackville (1536–1608)



Work cited	Quotations
Gorboduc, written with Thomas Norton (first performed 1651). Accessible on: http://www.luminarium.org/renascence-editions/gorboduc.html	<i>Formed is thy heart, but of hard iron wrought And wild and desert woods bred thee to life:</i>

Gorboduc was a mythical King whose dates are long before those of Sackville. Is there a play on ‘wrought iron’ in the statement quoted? It is possible, as wrought iron (strictly, ‘worked iron’) has been made from several centuries BC up to the present time [1]. Up until the 1790s, encompassing Sackville’s day and whatever era the play is set in, charcoal was used in making wrought iron.

Reference

[1] http://www.realwroughtiron.com/about_wrought_iron-217.html

8 Edmund Spenser (1552–1599)



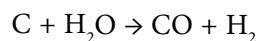
Work cited	Quotations
<p>The Faerie Queene</p> <p>Accessible on: http://www.poetryfoundation.org/poem/174459</p>	<p><i>Oft fire is without smoke, And perill without show: therefore your stroke Sir knight with-hold, till further triall made...</i></p>
<p>Ice and Fire.</p> <p>Accessible on: http://www.poemhunter.com/poem/ice-and-fire/</p>	<p><i>My love is like to ice, and I to fire: How comes it then that this her cold so great Is not dissolved through my so hot desire...</i></p> <p><i>...my exceeding heat Is not allayed by her heart-frozen cold, But that I burn much more in boiling sweat, And feel my flames augmented manifold?</i></p> <p><i>That fire, which all things melts, should harden ice, And ice, which is congeal'd with senseless cold, Should kindle fire by wonderful device?</i></p>

Spenser's assertion that fire is often without smoke was an interesting one for the times. In the 21st Century we should expect, for example, a natural gas flame to free from smoke or a flame from fuel oil on a properly designed and adjusted burner. Spenser and his contemporaries would have been more accustomed to such things as wood fires where smoke is highly evident. The only smokeless fuel in Spenser's time would have been charcoal and, possibly, anthracite coal. By the time Spenser wrote 'The Faerie Queene' there was heavy demand for charcoal in the production of iron for weapons [1] and he might well have been thinking of the glowing beds of charcoal in this application when he made his remark about fire without smoke. (The modern counterpart of such a device is of course the blast furnace.) Anthracite coal burns with little smoke on account of its low volatile matter content. Anthracite was being produced on a significant scale in Wales by the time Spenser wrote 'The Faerie Queene' [2], and it is reasonable to surmise that he had seen anthracite burning.

Heat in a poetic paradigm is the whole basis of 'Ice and Fire'. In the statement 'my exceeding heat is not allayed by her heart-frozen cold' fire extinguishment is being invoked in a figurative sense. There were fire extinguishers in Spenser's time, and very much earlier, and water was always the extinguishing agent (this of course is not true nowadays, when alternatives include carbon dioxide). In the 1500s there were in Germany devices called squirts which used a small manual pump to direct water at a fire [3], and these had come into being in London by the Great Fire of 1666. Whether Spenser ever saw such a device in action is difficult to conjecture, but not central to analysis of his poem.

That one uses water to quench fire is one of the most basic of human instincts, though Spenser's reference to ice rather than to liquid water suggests that his thinking had gone beyond simple analogy. 'Congealed with senseless cold' is an interesting description of ice vis-à-vis liquid water. Had Spenser observed that when a quantity of water forms ice there is no change in temperature until conversion to ice is complete? Beyond then the ice can be cooled to lower temperatures than the freezing point. This follows from the phase rule which was formulated in 1875 by Gibbs, long after Spenser's day. The present author's view is that there had been casual empirical observations of that long before 1875. Thermometers were only just coming into being by the time Spenser died, notably that invented by Galileo in 1593, but the human fingertips are in fact a remarkably good temperature sensor. People in and long before Spenser's time observing the freezing of water would by simple touch have been able to detect the constancy of ice temperature during freezing and drops in temperature, in a sub-zero climatic environment, after freezing. That Spenser had at least a limited awareness of this can reasonably be conjectured from his poem. Drops in the temperature beyond freezing reflect what much later became known as sensible heat in contrast to latent heat. When latent heat is being released (as in freezing) or supplied (as in melting) there is no temperature change, which is why the term contrasts with sensible heat which can be 'sensed'. Neither term existed in Spenser's day. Formation of ice is a latent heat effect: whether Spenser was unwittingly anticipating much later usage by the term 'congealed with senseless cold' is an interesting speculation.

The view that ice might 'kindle fire', though meant by Spenser in a poetic sense, cannot be dismissed from scientific reality. If water vapour is brought into contact with a carbonaceous fuel such as coal it undergoes the reaction:



thereby forming a fuel gas as both products – carbon monoxide and hydrogen – are combustible. This has been widely applied in combustion technology for over a century and again Spenser's discourse if viewed for conformity to science long postdating him stands up.

References

- [1] http://www.ukagriculture.com/countryside/charcoal_history.cfm
- [2] Hughes S. 'Copperopolis: Landscapes of the Early Industrial Period in Swansea' Royal Commission on the Ancient and Historical Monuments of Wales, 2008.
- [3] <http://www.firesafe.org.uk/history-of-fire-extinguishers/>

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9 Sir Philip Sidney (1554–1586)



Work cited	Quotation
Astrophil and Stella (c. 1580s). Accessible on: http://www.poetryintranslation.com/ PITBR/English/Sidney1thru27.htm	From Sonnet 9: <i>They are of touchwood/paper and I am the poor straw they set light to.</i>

‘Touchwood’ features in the discussion of John Webster, a contemporary of Sidney. The quotation is reminiscent of the appallingly cruel practice of those times of burning at the stake, in which straw was used as well as wood. Why, if this interpretation is correct, did Sidney draw on this unspeakably horrible practice in his sonnet? Moving in ‘high society’ throughout his life he’d have been aware that a Scottish noblewoman Janet Douglas, Lady Glamis was burnt at the stake on suspicion of witchcraft in 1537 [1]. People of his parents’ generation would have remembered it clearly enough. Sidney was born during the five-year reign of Mary Tudor, during which there were 274 executions by burning in England [2]. He had done military duty in Spain where, at a time only just outside living memory, there had been numerous burnings as part of the Inquisition.

References

- [1] <http://www.douglashistory.co.uk/history/ladyjanetdouglas.htm>
- [2] <http://www.capitalpunishmentuk.org/burning.html>

10 George Peele (1556–1596)



Work cited	Quotations
Famous Chronicle of King Edward the First (printed in 1593). Accessible on: http://www.poetryexplorer.net/poem.php?id=10114480	<i>And shouldst thou pass the ford of Phlegethon.</i>

Phlegethon is in mythology a burning river. It features in this book because of its obvious etymological link with 'phlogiston', a link confirmed in many sources including [1]. The phlogiston theory, which came into being about 70 years after the life of George Peele, was that fire arose from the existence of an agent, called 'phlogiston', within a substance. Dismissal of the theory was due to Lavoisier.

References

[1] <http://stmhumanities.blogspot.com.au/2014/10/phlegyas-phlegethon-and-phlogiston.html>

11 Thomas Kyd (1558–1594)



Work cited	Quotation
A Spanish Tragedy (written 1587). Act 3 Scene 14.	<i>BALTHAZAR: New kindled flames should burn as morning sun.</i>
Arden of Faversham (written c. 1592, close to the end of Kyd's life). Accessible on: https://archive.org/stream/ardenoffeversham00bayn/ardenoffeversham00bayn_djvu.txt	Act 4 Scene 2. <i>FERRYMAN: ...then looks he as if his house were a-fire, or some of his friends dead.</i> Act 4 Scene 3. <i>ALICE: Here 's to pay for a fire and good cheer : Get you to Feversham to the Flower-de-luce, And rest yourselves until some other time.</i>

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Kyd's (or Balthazar's) expression quoted is not easy to analyse in scientific terms if indeed it has a scientific basis at all. An analogy between dawn and dusk and the initial growth of a fire and its eventual decay through fuel depletion is weak not least because a wood fire for example burns in what modern combustion experts would call a quasi-steady way for most of the duration of the fire. Was he thinking of the weaker illumination of a 'newly kindled' fire than that from a quasi-steady one? That is more plausible. It is worth noting, even though it is most unlikely to be more than coincidence, that Kyd wrote those words at just the time that the Danish Tycho Brahe proposed his model for the solar system which became known as the Tychonic system [1].

Moving on the 'Arden of Faversham' it is relevant to note that the play was written at a time before fire insurance became available. In fact, fire insurance was a spin-off from the Great Fire of London in 1666, many years after the play under discussion, so the individual to whom 'Ferryman' was addressing those words would so to speak have been 'on his own' if his house had burnt down. The loss of proportion in likening that to the death of friends is perhaps less surprising when seen in that light. Flower-de-luce (Fleur de Lys) was a pub in Faversham in the southern county of Kent, made more attractive by its having, evidently, an open fire. (The saleability of this sort of ambience is known to the English licensees of the 21st Century!) In Kyd's day Kent was one of the main suppliers of fire wood for southern England, including London where it was used additionally to coal, and the fire at the Flower-de-luce was almost certainly wood⁵. Of course, nobody in those days knew that wood has the advantage over coal of being carbon-neutral.

Reference

- [1] <http://www.mlahanas.de/Physics/LX/TychonicSystem.html>
- [2] http://www.faversham.org/history/people/arden_playSynopsis.aspx

12 Thomas Lodge (1558–1625)

Work cited	Quotations
Rosalynde: Euphues Golden Legacie (published in 1590). Accessible on: http://www.gutenberg.org/files/17181/17181-8.txt	<i>When Saladyne had a long while concealed a secret resolution of revenge, and could no longer hide fire in the flax, nor oil in the flame...</i> <i>The iron yields with hammer, and to heat.</i>

The first statement quoted is a reference to the fact that Saladin (1138–1193) used thermal weapons; what we'd now call R&D into them was done on his behalf. In Lodge's time [1] charcoal would have been used in melting iron, in a device called a cupola, to which air is admitted during operation. This causes some of the charcoal to be converted to carbon monoxide which, even in the diluted state it is in because of the nitrogen which accompanies the oxygen into the cupola, burns with a high enough temperature to melt iron. This procedure is an anticipation of the gas producer which, largely through the endeavours of the Siemens brothers, came into existence in the 19th Century. These were used well into the 20th century to melt steel, a performance equivalent to that recorded by Lodge. The cupola, a device of considerable complexity even in modern terms, was a long way from being innovative even by his time. The industrial revolution did not in any way signify commencement of ingenuity in the application of heat to human needs and devices!

Reference

[1] http://www.faversham.org/history/people/arden_playSynopsis.aspx

13 Robert Greene (1558–1592)

Work cited	Quotations
Greene's Groats-worth of Wit (published posthumously).	<i>Remember Gentlemen, your lives are like so many lighted Tapers, that are with care deliuered to all of you to maintaine: these with wind-puft wrath may be extinguisht, which drunckenes put out, which negligence let fall:</i>

‘Tapers’ are raised in the discussion of the work of Thomas Middleton (1580–1627) and were in the 16th Century also referred to as ‘wands’ [1]. They had at that time and more recently a role additional to that of an ignition device: an (obviously) unlit one would be used in by a physician called upon to free a stuck element of food from a patient (‘esophageal dilation’). A piece of whale bone was an alternative (or perhaps complementary) implement.

The term ‘wind-puft wrath’ by Greene is also deserving of analysis. In a wealthy household of the time it would have been seen as slothful and unrefined for a domestic to blow out a taper or a candle, and a snuffler would have been used. (This is of course still the practice where candles are used in churches.) So it would only have been in ‘wrath’, without much regard for appearances, that a taper was blown out with human breath and Greene’s meaning is clear.

Reference

[1] Richter J.E. ‘The Esophagus’ John Wiley (2012).

14 Anthony Munday (1560–1633)

Work cited	Quotations
<p>The Downfall of Robert, Earle of Huntingdon (written 1598).</p> <p>Accessible on: http://d.lib.rochester.edu/teams/text/downfall-of-robert-earle-of-huntington</p>	<p><i>SERVANT: Even heavie news, my Lord; for the light fire Falling, in manner of a fier drake, Upon a barne of yours, hath burnt six barnes, And not a strike of corne reserv'd from dust.</i></p> <p>The 'Earle of Huntingdon' is identified with Robin Hood, so the narrative can be taken to be set in the 12th Century.</p>

The wilful destruction by fire of six barns of corn is described in the quotation from 'The Downfall of Robert, Earle of Huntingdon'. A 'strike' of corn is equivalent to a bushel, or 8 gallons⁶. Not even that much remained after the fire! There is evidence of fire spread: one 'barne' was as we'd say nowadays torched and six destroyed. The barn was a monastic one, typical of the 12th Century. It is not, working with the degree of approximation one has to in such conjectures, too long a shot to compare a barn from the late 12th Century with one from the 13th which is still extant and has a capacity of half a million cubic feet [1]. This too was a monastic barn and is in Hampshire, England.

Half a million cubic feet equates to 0.4 million bushels, and as six barns were burnt the amount of corn lost would have been 2.4 million bushels. The loss reported in the play was therefore very heavy. At that time and indeed much later corn was like currency which is why right up to industrial times major cities would have a 'corn exchange'. To a considerable degree the same is true today of crude oil.

References

[1] <http://www.newforestexplorersguide.co.uk/heritage/beaulieu/introduction.html>

15 Thomas Hariot (1560–1621)



Work cited	Quotations
A Brief and True Report of the New Found Land of Virginia (first published 1588).	<p><i>There is a kind of berrie or acorne, of which there are fие sorts that grow on seuerall kinds of trees; the one is called Sagatémener, the second Osamener, the third Pummuckóner. These kind of acorns they vse to drie vpon hurdles made of reeds with fire vnderneath almost after the maner as we dry malt in Engla~d. When they are to be vsed they first water them vntil they be soft & then being sod they make a good victual, either to eate so simply, or els being also pounded, to make loaues or lumpes of bread.</i></p> <p><i>...and also by lime made of Oister shels, and of others burnt, after the maner as they vse in the lles of Tenet and Shepy, and also in diuers other places of England:</i></p> <p><i>There is an herbe which is sowed a part by it selfe & is called by the inhabitants vppówoc: In the West Indies it hath diuers names, according to the seuerall places & countries where it groweth and is vsed: The Spaniardes generally call it Tobacco.</i></p>

The first and rather lengthy quotation from the work of Hariot (sometimes spelt Harriot) is a recipe for making ‘victuals’ from a vegetable substance he had discovered in his pioneering journey throughout Virginia. He probably saw it as being of value to future settler communities there. With reference to the second quotation, Shepy (now Sheppey, an island in the Medway) was at the time Hariot wrote that producing copper (as cooper sulphate) for colouring of wool [1]⁷. That oysters were obtained at Isle of Tenet (now the Isle of Thanet) in Kent long before Hariot’s time is clear: King John granted the ‘oyster grounds there to Faverhsam Abbey [2]⁸. Again, Hariot is making comparisons with England with an eye to the needs of future residents. Hariot recognises tobacco in Virginia, the substance having been brought to England in 1585 by Sir Walter Raleigh although it had been discovered about a century before then.

References

- [1] <http://www.sees-uk.co.uk/StevensHistory/coppras.htm>
- [2] Brayley E.W. ‘Delineations Historical and Topographical, of the Isle of Thanet and the Cinque Ports’ Sherwood, Neely, and Jones (1817).

16 Sir Francis Bacon (1561–1626)



Work cited	Quotations
History of Life and Death (Published 1638).	<i>In one and the same fire, clay grows hard and wax melts.</i>
Of Wisdom for a Man's Self (Published 1635).	<i>It is the nature of extreme self-lovers, as they will set a house on fire, and it were but to roast their eggs.</i>
'Natural History in Ten Centuries' (Published posthumously in 1627)	<i>Take an arrow, and hold it in flame for the space of ten pulses, and when it cometh forth you shall find those parts of the arrow which were on the outsides of the flame more burned, blacked, and turned almost to coal, whereas the midst of the flame will be as if the fire had scarce touched it. This is an instance of great consequence for the discovery of the nature of flame; and sheweth manifestly, that flame burneth more violently towards the sides than in the midst.</i>

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'The Proficience and Advancement of Learning' (published 1605)	<i>...who by their faculty of playing put the Pannonian armies into an extreme tumult and combustion.</i>
Of Seditions and Troubles (essay first published in 1597). Accessible on: http://www.luminarium.org/renaissance-editions/bacon.html	<i>For if there be fuel prepared, it is hard to tell, whence the spark shall come, that shall set it on fire.</i>

Bacon has made an important point in the one sentence quoted from his 'History of Life and Death'. Fire can be either useful – the production of ceramics from clay is the example he uses – or destructive. In the parlance of present-day combustion specialists there is 'friendly combustion' and 'hostile combustion'. The contrast is even more evident in the second quotation from Bacon. 'Barbecued' eggs are available in countries including Thailand.

Reference [1] in commenting on the quotation from Bacon's 'Natural History in Ten Centuries' says that 'there is no combustion within the flame which is not mixed with air'. This is correct, as any burner at that time would have been a torch, working along the lines of a candle in which fuel-air contacting is by diffusion, so the parts of the arrow in the 'midst' of the flame were in hot unburnt fuel. A burner nowadays uses pre-mixed air and fuel and this leads to a temperature profile within the flame quite different from that of a diffusion flame. Bacon would have observed different results if, for example, he had been able to use a Bunsen burner instead of a lighted torch, but that would not have been possible at least until 1855.

A point of equal interest not picked up in [1] is this: the arrow was not destroyed by fire and the blackening effect noted was due not to combustion but to the pyrolysis – thermal breakdown – which precedes and accompanies combustion. The course of events in Bacon's experiments would have been as follows. Heat from the flame caused the wood of which the arrow is made to decompose into three classes of product: solid, liquid (including methanol, known as 'wood alcohol') and gaseous. The liquid products are combustible as are most of the gaseous ones (carbon dioxide is an exception) but they diffuse out of the flame into the cool environment before there is time for them to burn in whatever limited oxygen is present in the flame. The only way in which someone doing such an experiment at that time would have been conscious of these products was the sense of smell. The solid wood having thus broken down chemically would become richer in carbon, entirely consistently with its blackened appearance, and this is the solid pyrolysis product. This too is combustible and would have burnt to destruction if it had been held in the flame for longer than the 'space of ten pulses' (about 6 seconds). This longer time would have been needed for oxygen entry to the burning zone.

Use of the word 'combustion' in Bacon's 'Advancement of Learning' is interesting in that it was at almost exactly the same time that Shakespeare made his only use of that term in the entire corpus of his work, actually in 'Macbeth'⁹.

In the quotation from 'Of Seditions and Troubles' Bacon is using fire as a figure of speech, but that does not preclude analysis and he supposed what very many since have continued to suppose: that there must be an ignition source ('spark', otherwise a flame generated by friction) for a fire to start. As mentioned in the present book it was known long before Bacon's day that a fire can arise without an ignition source and those resident in rural settings were conscious of this with haystacks¹⁰. By Bacon's time the effect had almost certainly been observed with coal and with wood. It is not being suggested that Bacon was in error, simply that what he says if taken beyond its poetic sense needs re-evaluation.

References

[1] http://todayinsci.com/B/Bacon_Francis/BaconFrancis-Quotations.htm



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17 Michael Drayton (1563–1631)



Work cited	Quotations
To the Noble Lady (Sonnet, published along with other sonnets in 1594). Accessible on: http://www.gutenberg.org/files/17873/17873-h/17873-h.htm	<i>Your like we in a burning Glasse may see, When the Sunnes rayes therein contracted be Bent on some obiect, which is purely white, We finde that colour doth dispierce the light, And stands vntainted:</i>

The matter of focusing solar flux to create heat is raised in the discussion of 'Clarissa' by Samuel Richardson, which was in 1748¹¹. The date of this and that of Drayton's recording of the same effect straddle Isaac Newton's prism experiments, reported in 1665 [1]. It is not being fanciful to see an anticipation of it in the verse from Drayton. Anyone who had ever thoughtfully observed a rainbow might have made the conceptual link.

Reference

[1] <http://micro.magnet.fsu.edu/primer/java/scienceopticsu/newton/>

18 Christopher Marlowe (1564–1593)



Work cited	Quotations
<p>Tamburlaine the Great Second Part (written c. 1690). Accessible on: https://ebooks.adelaide.edu.au/m/marlowe/christopher/tambur2/complete.html</p>	<p><i>TAMBURLAINE: As I have conquer'd kingdoms with my sword. This cursed town will I consume with fire, Because this place bereft me of my love; The houses, burnt, will look as if they mourn'd;</i></p> <p><i>TAMBURLAINE: ...this town shall ever mourn, Being burnt to cinders for your mother's death.</i></p> <p>Play set in 14th/15th Century Central Asia. Many references to the burning of the town in which Zenocrate, wife of Tamburlaine, died.</p>
<p>The Jew of Malta (written c. 1590) Act II. Accessible on: http://www.gutenberg.org/files/901/901-h/901-h.htm</p>	<p><i>FERNEZE: We'll send thee bullets wrapt in smoke and fire...</i></p> <p>Play set in the Ottoman Empire, which existed from the mid 14th Century to the mid 15th.</p>
<p>Doctor Faustus (published posthumously in 1604). Accessible on: https://www.gutenberg.org/files/779/779-h/779-h.htm</p>	<p>From the rubric: Re-enter MEPHISTOPHILIS with a chafer of coals.</p>
<p>Hero and Leander (written 1593, origin in Greek Mythology).</p>	<p><i>Love kindling fire, to burn such towns as Troy .</i></p>

Tamburlaine's approximate counterpart in strict historical data is Timur (1336–1405), an Islamic ruler and warrior. When in 1398 he took Delhi in India he had camels, whereas his Indian opponents had much heftier elephants. He loaded the camels (and also some buffaloes which happened to be on the scene) with hay and straw which he then ignited. The camels and buffaloes, obviously in agony, charged towards the elephants which, on experiencing the flames, heat and smoke, themselves panicked and dispersed, causing some Indian casualties in the stampede. Timur, who was previously aware of the propensity of elephants to behavioural disorientation on being alarmed, easily won the battle [1]. That many will see Timur's exploitation of the camels and buffaloes in that way as being abhorrent is obvious, but a debate on that is outside the scope of this text.

Moving on to 'The Jew of Malta' (following row), it was noted in the part of this book on Shakespeare that gunpowder was available in Europe in the 13th Century, well in time therefore for the Ottoman Empire. Interpretation of 'bullet' is a little less straightforward. It probably means, here, a cannonball. The character Ferneze, quoted in the table, also says:

*Till you shall hear a culverin discharg'd
By him that bears the linstock, kindled thus*



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The linstock is the device by means of which, from a safe distance, the ignition source for a weapon is applied. ‘Culverin’ is, quite simply, a synonym for ‘cannon’ [2]. A ‘chafer of coals’ (following row) means a container – dish or pan – containing coal or charcoal. That ‘coal’ in the period of interest in this book sometimes means ‘charcoal’ has been noted.

In mentioning the destruction of Troy by fire Marlowe cannot have been making a comparison with the Great Fire of London, which did not occur until 1666. The only destruction of a city by fire in the British Isles anywhere near to Marlowe’s lifetime was Edinburgh in 1544, twenty years before his birth. The details of this would have been known to Marlowe’s teachers at King’s School Canterbury, and that he heard of the Edinburgh fire from them as well as from others a generation older than himself, is almost certain. Unlike the Great Fire of London, the Edinburgh fire of 1544 was no accident. It was an act of belligerence on the part of England [3]. Knowledge of the destruction of Troy by fire is not plentiful, although it has been reliably established that it was in about 1200 BC. A historian has to be attentive in paring legend away from fact in analysis of events from so long ago. It is not however doubted that, like the Edinburgh fire colossally later, the destruction of Troy by fire was an act of hostility. In the mind of the young Marlowe (he was only ever a young man: he suffered a violent death at age 29) the two would have been linked, largely subliminally. The bringing together of ancient and modern in informed minds and in the collective consciousness of societies is an important part of how history works. (If that had not been so the Bible would long since have lost its influence.) That is not of course to say that the Edinburgh fire in 1544 and the destruction of Troy were in Marlowe’s mind being identified the one with the other.

References

- [1] ‘Timur the Great’ Lulu Press (2014)
- [2] <http://www.britannica.com/technology/culverin>
- [3] <http://www.bbc.co.uk/scotland/education/int/hist/mary/act1/wooing/int1.shtml>

19 William Shakespeare (1564–1616)



Work cited	Quotations
Henry V (written c. 1599) Act 3, Scene 6. Accessible on: http://shakespeare.mit.edu/henryv/henryv.3.6.html	<p><i>FLUELLEN: ...his face is all bubukles, and whelks, and knobs, and flames o' fire: and his lips blows at his nose, and it is like a coal of fire, sometimes plue and sometimes red; but his nose is executed and his fire's out.</i></p> <p>Fluellen, a soldier in King Henry's army, describes Bardolph.</p>
Merchant of Venice (written c. 1598) Act 5, Scene 1. Accessible on: http://nfs.sparknotes.com/merchant/page_212.html	<p><i>PORTIA: That light we see is burning in my hall. How far that little candle throws his beams! So shines a good deed in a naughty world.</i></p> <p>Spoken to Portia's handmaid Nerissa.</p>
Merry Wives of Windsor (written c. 1597) Act 1, Scene 4. Accessible on http://www.opensourceshakespeare.org/views/plays/play_view.php?WorkID=merywives&Act=1&Scene=4&Scope=scene	<p><i>HOSTESS QUICKLY: Go; and we'll have a posset for't soon at night, in faith, at the latter end of a sea-coal fire.</i></p> <p>Hostess Quickly, a.k.a. Mistress Quickly, an innkeeper.</p>
The Two Gentlemen of Verona (written c. 1590) Act 2, Scene 7. Accessible on: http://www.shakespeare-online.com/plays/two_2_7.html	<p><i>JULIA: Thou wouldest as soon go kindle fire with snow As seek to quench the fire of love with words.</i></p> <p>Julia a 'young noblewoman from Verona' [9].</p>

<p>Venus and Adonis (poem written c. 1592).</p> <p>Accessible on: http://shakespeare.mit.edu/ Poetry/VenusAndAdonis.html</p>	<p><i>She red and hot as coals of glowing fire, He red for shame, but frosty in desire...</i></p> <p><i>He sees her coming, and begins to glow, Even as a dying coal revives with wind...</i></p> <p><i>Affection is a coal that must be cool'd; Else, suffer'd, it will set the heart on fire...</i></p> <p>Plot taken from Ovid.</p>
<p>Sonnet 1 (first published 1609).</p> <p>Accessible on: http://www.shakespeare-online. com/sonnets/1.html</p>	<p><i>Feed'st thy light's flame with self-substantial fuel...</i></p>
<p>Hamlet (written c. 1600) Act 2, Scene 2.</p> <p>Accessible on: http://nfs.sparknotes.com/ hamlet/page_94.html</p>	<p><i>LORD POLONIUS: Doubt thou the stars are fire, Doubt that the sun doth move...</i></p> <p>Visible emissions from stars are from nuclear fusion. See further comments in the main text.</p>



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<p>Much Ado about Nothing (written 1598) Act 1, Scene 1.</p> <p>Accessible on: http://shakespeare.mit.edu/much_ado/full.html</p>	<p><i>HERO: Therefore let Benedick, like cover'd fire, Consume away in sighs, waste inwardly...</i></p> <p>Comparison made below with a poem by John Dryden.</p>
<p>Richard II (written c. 1595) Act 2, Scene 1.</p> <p>Accessible on: http://shakespeare.mit.edu/richardii/richardii.2.1.html</p>	<p><i>JOHN OF GAUNT: For violent fires soon burn out themselves; Small showers last long, but sudden storms are short...</i></p> <p>Play set in the reign of Richard II 1377–1399.</p>
<p>Edward III Act 1, Scene 2.</p>	<p><i>COUNTESS: and where the upper turf doth boast his pride...</i></p> <p>Edward III reigned from 1327 to 1377. Whether all of this play was the work of Shakespeare is debated.</p>
<p>Taming of the Shrew (written c. 1590). Induction, Scene 1.</p> <p>Accessible on: http://nfs.sparknotes.com/shrew/page_6.html</p>	<p><i>LORD: Balm his foul head in warm distilled waters And burn sweet wood to make the lodging sweet.</i></p> <p>'Inductions' rare in Shakespeare's plays.</p>
<p>Macbeth (usually dated 1606) Act 2 Scene 3.</p>	<p><i>LENNOX: And prophesying with accents terrible Of dire combustion and confused events New hatched to the woeful time.</i></p> <p>Reference to the Gunpowder plot of 1605. The only time Shakespeare uses the word 'combustion' in one of his plays [16]. See further comments in the main text.</p>
<p>Othello (written c. 1603) Act 2 Scene 3.</p>	<p><i>OTHELLO: Passion, having my best judgement collied, Assays to lead the way.</i></p>
<p>Coriolanus (written c. 1608) Act 1 Scene 1.</p>	<p><i>MARCIUS: ...you are no surer, no, Than is the coal of fire upon the ice, Or hailstone in the sun.</i></p> <p>Play set 5th century BC.</p>
<p>King Lear (written c. 1603) Act 4 Scene 7.</p>	<p><i>LEAR:...mine own tears Do scald like molten lead.</i></p>
<p>As You Like It (written c. 1599) Act 1 Scene 1.</p>	<p><i>ADAM: this night he [Orlando's brother] means To burn the lodging where you [Orlando] use to lie And you within it:</i></p>
<p>Sonnet XII (first published 1609).</p>	<p><i>When lofty trees I see barren of leaves, Which erst from heat did canopy the herd...</i></p>
<p>Love's Labour's Lost (written c. 1605) Act 4 Scene 3.</p>	<p><i>DUMAINE: To look like her are chimney sweepers black.</i></p>
<p>The Winter's Tale (first published 1623) Act 5 Scene 2.</p>	<p><i>SECOND GENTLEMAN: Nothing but bonfires: the oracle is fulfilled; See discussion of 'bonfires' in the coverage of Jonson's 'The Forest' and of Dekker's 'The Noble Spanish Soldier'.</i></p>

<p>King John Act 3 Scene 1.</p>	<p><i>I am burn'd up with inflaming wrath; A rage whose heat hath this condition...</i></p> <p>Set in the reign of King John 1199–1216.</p>
<p>Twelfth Night (written c. 1601) Accessible on: http://www.gutenberg.org/cache/epub/1526/pg1526-images.html</p>	<p><i>FABIAN: ...and with some excellent jests, fire-new from the mint, you should have banged the youth into dumbness.</i> <i>SIR TOBY BELCH: Come, come; I'll go burn some sack;</i></p>
<p>Anthony and Cleopatra (first performed c. 1607). Accessible on: http://www.gutenberg.org/cache/epub/1796/pg1796-images.html</p>	<p><i>ANTHONY: Our overplus of shipping will we burn.</i> Play set c. 30 BC.</p>
<p>The Comedy of Errors (published 1592). Accessible on: http://www.gutenberg.org/cache/epub/2239/pg2239-images.html</p>	<p><i>...light is an effect of fire.</i> <i>I warrant, her ragges and the Tallow in them, will burne a Poland Winter: If she liues till doomesday, she'l burne a weeke longer then the whole World.</i></p>
<p>Titus Andronicus (written circa 1590). Accessible on: http://shakespeare.mit.edu/titus/full.html</p>	<p><i>AARON: Set fire on barns and hay-stacks in the night...</i> <i>TITUS ANDRONICUS: What fool hath added water to the sea, Or brought a faggot to bright-burning Troy?</i></p>
<p>Cymbeline, King of Britain (first produced c. 1610). Act 3, Scene 1. Accessible on: http://www.gutenberg.org/cache/epub/1133/pg1133-images.html</p>	<p><i>QUEEN: ...to master Caesar's sword, Made Lud's Town with rejoicing fires bright And Britons strut with courage.</i></p> <p>Other references to Lud's Town in the play.</p>
<p>Henry VIII (written c. 1613 collaboratively with John Fletcher). Accessible on: http://www.gutenberg.org/cache/epub/1136/pg1136-images.html</p>	<p><i>NORFOLK: The fire that mounts the liquor till't run o'er</i> <i>LOVELL: Pertaining thereunto-as fights and fireworks</i> <i>QUEEN KATHARINE: Have blown this coal betwixt my lord and me- Which God's dew quench! ...Yea, the whole Consistory of Rome. You charge me That I have blown this coal:</i></p>
<p>Henry VI Part 3 (written in 1591). Act 5, Scene 1. Accessible on: http://www.gutenberg.org/cache/epub/1102/pg1102-images.html</p>	<p><i>KING EDWARD: This hand, fast wound about thy coal-black hair...</i></p> <p>Henry VI reigned from 1422 to 1461.</p>

<p>Pericles, Prince of Tyre (first performed 1619).</p> <p>Accessible on: http://shakespeare.mit.edu/pericles/full.html</p>	<p>Act 1 Scene 4. <i>PERICLES:...Be like a beacon fired to amaze your eyes.</i></p> <p>Act 2 Scene 2. <i>THAISA: A burning torch that's turned upside down;</i> <i>The word, 'Quod me alit, me extinguit.'</i></p>
<p>Julius Caesar (written 1599).</p> <p>Accessible on http://shakespeare.mit.edu/julius_caesar/full.html</p>	<p>From Act 1 Scene 3. <i>CASSIUS: Those that with haste will make a mighty fire Begin it with weak straws:</i></p> <p>Julius Caesar's lifetime was 100 BC to 44 BC.</p>
<p>The Rape of Lucrece (written 1594).</p> <p>Accessible on: http://shakespeare.mit.edu/Poetry/RapeOfLucrece.html</p>	<p><i>TO THE RIGHT HONORABLE HENRY WROTHESLY, Earl of Southampton, and Baron of Tichfield. The love I dedicate to your lordship is without end; whereof this pamphlet...</i></p>
<p>The Two Noble Kinsmen (first published 1634, therefore after Shakespeare died, and co-authored with John Fletcher.)</p> <p>Accessible on: http://www.gutenberg.org/cache/epub/1542/pg1542-images.html</p>	<p><i>EMILIA: No more be hid in him then fire in flax.</i></p>

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<p>The Merry Devil of Edmonton (published c. 1600).</p> <p>Part of the 'Shakespeare Apocrypha'</p> <p>Accessible on: http://www.fullbooks.com/ The-Merry-Devil.html</p>	<p><i>With smoke, more chargeable then Cane-tobacco; His hawks devour his fattest dogs</i></p>
<p>A Midsummer Night's Dream (written between 1590 and 1597).</p>	<p><i>HERMIA: And by that fire which burned the Carthage queen... ROBYN: Now the wasted brands do glow</i></p>

Like many of Shakespeare's plays Henry V is set at a time well before his own. Henry V reigned from 1413 to 1422, so the reference to a 'coal of fire' has to be related to that time, not to Shakespeare's. We are informed in [1] that 'plue' means 'blue'. The comparison with a 'coal of fire' is of course a simple simile. The important question from the point of view of this analysis is how an Englishman of the 15th Century would have encountered coals of fire in day-to-day experience sufficiently to use it as the basis of a figure of speech. In fact Fluellen (or his authentic counterpart: unlike Henry V himself, Fluellen was a fictional character) would have seen coal fires in domestic settings, which came into being in England in the 14th Century [2]. Coal was dug out from shallow deposits or retrieved from coastal settings having been released naturally from subsea beds. There was quite enough from such sources for the requirements of that time, when the population of England was two to three millions [3]. There is a return to this point later in the section on Shakespeare.

'The Merchant of Venice' (following row) is set in Shakespeare's own time. Portia was from the privileged classes, so that she had an attractive home (with a 'hall') with candle lighting is not surprising. A candle in the 16th Century would have been made either from tallow or from beeswax [4]. Candle wax from crude oil residue did not become available until the second half of the 19th Century. Given Portia's upmarket circumstances as noted, one can conjecture that the candles in her 'hall' were of the beeswax variety. These had, as a bonus, a pleasant odour in contrast to tallow candles which had the opposite, an acrid odour [4]. It is also recorded that beeswax candles burnt with less smoke than tallow ones, sometimes with no smoke at all. Here is a point in which an issue from long after Shakespeare's day is anticipated. When in the modern world a fuel is said to be 'dirty' that is a more a reflection on the combustion plant in which it is being burnt than an inherent difficulty with the fuel. In Portia's day the chandlers who made candles would have put what we now call R&D into the beeswax candles to make them burn smokelessly¹². The wick would probably have been made of twisted paper: cotton for such purposes did not become available until later¹³. The wick height and thickness as well as such factors as the candle diameter and its configuration close to the wick (for example, degree of being conical) would have been adjusted to get the best result. Obviously the costs of the R&D would have been passed along to the purchaser so such candles were for the better off like Portia. One might conjecture that there'd have been less R&D into the tallow candles used by poorer folk, who had to put up with the smoke. (There is a return to the matter of candle wicks in the part of this book dealing with the writings of John Bunyan.)

The Merry Wives of Windsor is set at a time approximately contemporaneous with Henry V. The reference to sea-coal is highly interesting. The term 'sea-coal' was in use in London at least a century before the time in which 'The Merry Wives of Windsor' is set [5,6]¹⁴. It is said to mean coal at subsea deposits close enough to the surface to be dug out, and taken to London for distribution from there [7]. One of the primary sources of such coal was the North Sea¹⁵ at the Tyne estuary¹⁶. There is in 2015 considerable interest in the subsea coal reserves of the North Sea [8] so continuity is evident. Sea-coal can also mean coal having drifted on to a beach from a subsea deposit¹⁷. An example of sea-coal on this sense is in Plate 1 below. It was mentioned on footnote 5 that there was once coal production in Kent, and the extends below the sea into the English Channel.



Plate 1. Sea coal from England's Kent coast. Image taken from:

https://www.google.com.au/search?q=sea+coal&biw=1297&bih=691&source=lnms&tbm=isch&sa=X&sqi=2&ved=0ahUKEwiwrqLX3MPJAhVkl6YKHVaDBYUQ_AUIBigB#imgrc=km615ylp29LUMM%3A

Julia's reference to snow in 'The Two Gentlemen of Verona' is an example of the figure of speech known as Adynaton, like the Matthean passage of a camel through the eye of a needle (of which, of course, Shakespeare would have been aware). Verona is in northern Italy where temperatures do drop to below 0°C in winter so Julia, who was from Verona, was drawing on experience in what she said. Being of high birth and having a privileged way of life, she had probably seen her minions 'kindle a fire' without having done so herself [9].

The 'coal' theme continues into Shakespeare's poem 'Venus and Adonis' which as noted has a classical derivation. Shakespeare's familiarity with coal and its obvious prominence in his thoughts probably arose from his frequent sojourns in London. In the middle of the 16th Century London, by then having a population of the order of 0.1 millions, obtained coal from Newcastle to the extent of about 250 kilogram per inhabitant per year [10]. The coal was shipped down the east side of England and into the Thames. It was used in cooking and heating. Shakespeare's responsive mind would have observed this and, in his characteristic way, assimilated and docketed it for use in his compositions. There is no evidence that Shakespeare ever went outside England [11]¹⁸ and he saw little of England itself beyond Stratford and London. The Stratford of that time was rural and insular [12]. That coal ever found its way there is counterintuitive in the extreme, for two reasons: London and the other cities (e.g. Liverpool, also a port) readily took up all of the coal which England could produce, and ther'd have been quite enough of what we now call biomass in a place like Stratford for heating needs. In other words it is to Shakespeare's time spent in London that we owe his observation of coal burning and therefore his references to it in his works.



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The term ‘self-substantial fuel’ in Sonnet 1 at first sight challenges the 21st Century exegete. The obvious interpretation is a fuel capable of ignition without application of a heat source, in other word spontaneous combustion. Whether a particular combustible substance such as a coal will ‘spontaneously ignite’ does not depend just on the nature and composition of the coal but on the amount. A single piece of coal held in the palm of the hand will not spontaneously ignite: a stockpile containing thousands of tonnes of the same sort of coal might. Had Shakespeare ever observed spontaneous combustion? Almost certainly he had, though involving not coal but hay. Haystack fires through spontaneous heating have been a widely observed phenomenon throughout recorded history. In 60 BC a Roman philosopher drew up guidelines for the prevention of haystack fires, including drying of hay before assembly of a stack [13]. Who can doubt that Shakespeare had observed haystack fires in Stratford and/or on his journeys to and from London? In any case haystack fires would have featured in neighbourhood conversation in places like 16th Century Stratford. That is not of course positive proof that Shakespeare was thinking of that in his use of the term ‘self-substantial fuel’¹⁹. A less appealing explanation is that the term means rapidly propagating, as with straw discussed in the coverage previously in this book of Chaucer’s ‘Merchant’s Tale’. It was argued in the previous paragraph how Shakespeare would have seen beds of coal in cooking and heating applications. He’d have noticed that such a bed needs replenishment of fuel less frequently than a fire using sticks of wood as fuel. Did that inspire ‘self-substantial’? Did all of three conjectures offered above combine, largely sub-consciously, in his highly fertile mind when he used that expression in his sonnet? Moving on to Hamlet in the next row, it should be noted that the view by Aristotle (384–322 BC) that everything observable was composed of four elements – earth, air, fire and water – persisted in some respects not only in Shakespeare’s time but even later than that. Charles Dickens’ use of these terms as ‘elements’ has been noted (e.g. [14]). That the term fire was applied to the sun and to other stars at periods long predating knowledge of nuclear physics and chemistry was inevitable and not *totally* invalid, as with fire no less than with stars it is thermal radiation in the visible region of the spectrum which gives rise to observed effects²⁰.

Moving on to ‘Much Ado about Nothing’ we note that the term ‘cover’d fire’ also occurs in the poem *Palamon and Arcite*, written by John Dryden and published in 1700, just over a century after ‘Much Ado about Nothing’. *Palamon and Arcite* is concerned with the same narrative as Chaucer’s ‘Knight’s Tale’ which was discussed in the section of this book on Chaucer. Dryden had probably noted the term as used by Shakespeare although it is unlikely that that was the first time he had encountered it. Dryden says:

*To grace the pomp came Emily the bright,
With cover’d fire, the funeral pile to light.*

In analysing the statement about a ‘violent’ fire in the quotation from King Richard II (following row) we first surmise that Shakespeare was contrasting it with a steady, quiescent fire: the comparison with ‘showers’ and ‘sudden storms’ which follows certainly suggests that. At the time the play is set, and later in Shakespeare’s own time, poorer people would have slept on a straw mattress. One can imagine that a fire has begun in a room containing such a mattress and that the mattress is burning slowly, almost quiescently, with plentiful smoke but hardly any visible light emission. Someone intervening in order to rescue the occupants of the room opens a door, and as a result of the increased air supply the mattress ceases to burn in that mild way and immediately displays vigorous flaming behaviour²¹. Such transitions are extremely common in room fires, and obviously the mattress having undergone the transition to flaming combustion would have been destroyed much more quickly than it would have been if the transition had not occurred. This is consistent with Shakespeare’s imagery and his comparison with showers and storms. By the time of the reign of Richard II there were tapestries containing linen and these too could have displayed this sort of combustion behaviour in which case the loss in financial terms would have been much heavier than for a humble straw bed!

In the quote in the following row ‘turf’ means ‘peat’ [15]. (This usage continues to the present time: the Spanish word for peat is *la turba*).²² At the time in which the play is set peat was used as a fuel in England [16] as well as in other parts of Europe. The matter of the fragrancing with burning wood featured when Chaucer’s work was being considered, and occurs in Shakespeare’s ‘Taming of the Shrew’ as noted.

Use of the word ‘combustion’ for the first and only time by Shakespeare in ‘Macbeth’ is a point of major interest [17]. There is the point that the authentic Macbeth reigned from 1040–1057 [18] so here Shakespeare was slipping a recent item of news into a historical account, though certainly only by way of comment. Shakespeare owed his knowledge of Macbeth and the circumstances of his life to Holinshed’s Chronicles, published in 1577. One can at least, consistently with the theme of the present book, consider whether a ‘gunpowder plot’ would have been possible during the reign of Macbeth. The answer is ‘Probably not’. Gunpowder was available in China in the 9th Century but did not find its way to Europe until the 13th [19], too late for a hypothetical assassination attempt in 11th century Scotland!

The word ‘collied’ in ‘Othello’ (following row) has been the source of debate amongst Shakespearean scholars. It is mentioned in this book because one feasible view [20] is that it means obscured as if by coal dust. The word collier, which dates from the 13th Century and therefore predates not only Othello but also the period in which it is set, originally meant someone who sells charcoal. That ‘collier’ rather than ‘coal’ might have been in Shakespeare’s mind when he used ‘collied’ is suggested in [20].

In the discussion of Macbeth above the point was made that a contemporary event – the Gunpowder plot – had slipped into a narrative by Shakespeare set considerably before his own time²³. According to [21] this is very much more true of the lines from Coriolanus quoted in the table. The London winter of 1607–1608 was so severe that coal in containers was used to melt the Thames. There’d have been an awareness of coal at the time of the setting of Coriolanus whether or not it was used at the scene of the narrative.

Nature imposes a restriction on combustion temperatures by the fact that the higher the amount of heat released by unit amount of fuel the greater the amount of combustion products (carbon dioxide and water) to take up the heat. This places an upper limit, depending on circumstances of heat loss from the combustion products to the surroundings, of something like 1000°C for coal or charcoal combustion. This well exceeds the melting point of lead which is 327.5°C and even a wood fire could be relied upon for that. That molten lead was known in Shakespeare's day and much earlier is not therefore surprising.

The gruesome proposal in 'As You Like It' (following row) that Orlando's house might, in a murder attempt on its occupant, be destroyed by fire can be examined. Orlando's residence was, it can reasonably be conjectured, what we'd now call an up-market one as his father was a nobleman. Timber, most likely oak, would have comprised a major proportion of the building materials, there also being brick and plaster [22]. It is noted in the section of this book on Thomas Browne that pitch was available in England in his day. It was used to weatherproof timber in domestic buildings (a factor in the rapid propagation of the Great Fire of London) as well as in ship construction. An arsonist targeting such a building would have required no particular ingenuity.

One could without being fanciful relate the quotation from Sonnet XII in the next row to global warming due to rising carbon dioxide levels. Photosynthesis – the process which removes carbon dioxide from the atmosphere – is adversely affected when the trees are 'barren of leaves'. Shakespeare is referring to shade by the tree canopy (a term still in use in forestry) in summer.



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The reference to chimney sweeps in ‘Love’s Labour’s Lost’ is commented upon in [23] where it is pointed out that there had been chimney sweeps in London before Shakespeare’s time. As a result of rebuilding after the Great Fire in 1666, chimneys in London residences became taller, providing more work for the sweeps.

It is interesting that ‘heat’ appears in ‘King John’ which was set in the 12th/13th centuries. Its use can be dated from before the 12th Century so it would have been in the vocabulary of King John (the word appears many times in the play). It is a point of some surprise that the word caloric (‘c’ as the last letter, not a misspelling of ‘calorie’) went into disuse whilst the much older word ‘heat’ survived. ‘Caloric’ belongs to the period of the commencement of thermal sciences when English and German influences were stronger than French in establishing terminology. The word ‘caloric’ was coined too late to have been in the vocabulary of Shakespeare. It did have a long lifetime in the form of ‘calorie’ which, even so, is now formally obsolete having been replaced by the English ‘joule’.

Turning to Twelfth Night, it has been pointed out [24] that the term ‘fire-new’ occurs in two other Shakespearean plays: King Lear²⁴ and Richard III²⁵. It has been conjectured [25] that to ‘burn some sack’ means to heat some wine for serving warm. Mention of burning the superfluous ships in Antony and Cleopatra (following row) is reminiscent of the fireships having been discussed in this book in relation to very much later periods. Antony and Cleopatra is set, as noted, a few decades BC and that fireships were used in conflict at sea long before then is certain. The earliest use of fireships, recorded in the diary of Sir Samuel Pepys [26], was in 415–413 BC in what became known as the Athenian Sicilian Expedition.

Moving on to ‘The Comedy of Errors’ we can speculate on whether the statement ‘light is an effect of fire’ quoted is merely an expression of what is obvious. Shakespeare wrote that in the lifetime of Galileo and of Kepler. That he made the remark on prompting from one or both of them is not being suggested: what is relevant is that the minds of men and women of intellect were being exercised by such matters by 1592 when ‘The Comedy of Errors’ was first published. That he slipped it in as something incidental is typical of how fundamentally important concepts first begin to propagate. The reference to tallow and contamination from it in the other quotation from ‘The Comedy of Errors’ is interesting: what is the origin of the expression to ‘burn a Polish winter’? Weather diaries for Cracow in Poland in the 15th and 16th centuries were kept and have recently been discussed in the light of climate change [27]. Trends recorded in those would have entered the conversation of those making trips between the two countries, so that the figure of speech quoted should have come into existence is not surprising.

Moving on to ‘Titus Andronicus’ it is believed to have been set towards the end of the Roman Empire, so we might for the purposes of this study put the date at about 450 AD. It was noted above that much earlier – in 60 BC – guidelines to prevent spontaneous heating of haystacks were developed and followed, but clearly in ‘Titus Andronicus’ it was intentional ignition by human agency – a.k.a. arson, a word not coined until very much later – which is under discussion. Once ignition has occurred by spontaneous heating or by intentional, malicious ignition, hay at the bulk density of a typical ‘stack’ burns very rapidly and powerfully, and total destruction soon follows. The play also contains reference to the destruction of Troy, as does one of the plays by Shakespeare’s contemporary Marlowe, as noted.

Moving on to *Cymbeline*, ‘Lud’s Town’ is of course London, and festive use of fire there is being proposed with enthusiasm to mark the spirit of the time. Henry VIII (following row), set much later, lends itself only to a few allusions to combustion which are minor and tentative without being insignificant. The notion that fire would mount a liquor has shades of what was said about Middleton’s ‘blue flame’, and fireworks are also common to Shakespeare and Middleton. More productive than speculation of what the expression to ‘blow a coal’ might mean is reflection on the fact that a figure of speech involving coal was in use in 16th century London society.

Coal-black hair is an interesting expression in ‘Henry VI Part 3’²⁶. Jet-black would be more common now and, as has been discussed elsewhere in the book, jet was available in England from Roman times onwards. That the term jet-black was at least coming into use in Chaucer’s time is clear from the following from ‘The Nun’s Priest’s Tale’:

His crest is redder than fine coral, his beak is black as jet.

In this discussion one can ‘trespass’ into the world of coal petrography, a discipline which came into being just about a century ago. Coal rich in certain organic minerals (‘macerals’) is reflective and glossy, whilst coal less rich in these is duller in appearance. King Edward’s remark in the quotation was presumably intended to mean glossy coal!

With reference to the word ‘Beacon’ in ‘Pericles’, it is noted in this book that the word was used about sixty years later by John Bunyan. Moving to the next quotation, ‘quod me alit me extinguit’ means ‘what feeds me extinguishes me’ [28] and is obviously a reference to the dangers of holding a ‘torch’ of the design of those times upside down. In fact several points of interest in combustion science can be made in relation to this. In the torch referred to in ‘Pericles’ fuel-air contacting was entirely be diffusion having therefore a gravity dependence, so to turn it upside down would well and truly sabotage it.

Imagine by contrast in this early 21st Century (or even a century earlier than that) a pipe contains natural gas at high pressure. Imagine that a leak develops in the pipe in such a way that gas exits vertically upwards and there is ignition. This is the counterpart of the correctly held torch in Pericles. Imagine now that instead the leak develops in such a way that gas exits vertically downwards and there is ignition. The downward flame would differ in structure surprisingly little from the vertical one, in contrast to the totally different behaviour when Pericles' torch is inverted. This is because gravity is a very much less important effect in the natural gas pipeline example, where fuel-air contact is driven not by diffusion but by the momentum with which the gas, previously under high pressure in the pipe, exits and entrains air. This was not totally unknown in Shakespeare's time: before 0 AD natural gas was, in a particular part of China [29], being conveyed in bamboo pipes for purposes including desalination of water. Such gas was not drilled for: it occurred by natural seepage.

Thermal weapons were in use by the regime of Julius Caesar, and indeed for centuries before. They consisted of rapidly propagating fires which would destroy cities. The technique of using straw initially in such action is fairly obviously the meaning of the passage quoted from 'Julius Caesar'.

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Turning our attention to the poem ‘The Rape of Lucrece’, it can be noted that the term ‘dying coal(s)’ is used in another Shakespearean poem:

*He sees her coming, and begins to glow,
Even as a dying coal revives with wind*

from ‘Venus and Adonis’, written in 1592. ‘Coal’ appears more times in ‘Venus and Adonis’:

She red and hot as coals of glowing fire, He red for shame, but frosty in desire.

and:

*Affection is a coal that must be cool'd;
Else, suffer'd, it will set the heart on fire*

and finally:

*And coal-black clouds that shadow heaven's light
Do summon us to part, and bid good night.*

It is explained in [30] how the plural ‘coals’ at that time and later meant pieces of coal formed by breakage of bigger ones. ‘Coal-black’ is an expression used, as recorded above, in ‘Henry VI Part 3’. It is a better expression than the stronger ‘jet-black’ to apply to something lacking a solid structure as clouds do.

In ‘The Two Noble Kinsmen’ there is yet another reference to fire in flax which, as explained in the discussion of Shakespeare’s Richard III, can mean a ‘slow match’. Tobacco had been introduced in England by Sir Walter Raleigh about fifteen years before ‘The Merry Devil of Edmonton’ was published. The reference to Cane-tobacco is not straightforward to interpret and the present author went down a number of false trails in his attempts to do so. It probably simply means that hollow pieces of cane were at that time and in some places used as a tobacco holders. The first reference from ‘A Midsummer Night’s Dream’ is taken from mythology, where Dido, first Queen of Carthage, is said to have climbed into a funeral pyre [31]. Reference [32] gives a modern meaning of the second quotation as ‘The charred logs glow in the fireplace’.

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20 Thomas Campion (1567–1620)



Work cited	Quotations
Fire, Fire, Fire! (1617, from the Book of Ayres).	<i>Fire, fire, fire, fire. Loe here I burne in such desire That all the teares that I can straine Out of mine idle empty braine Cannot allay my scorching paine. Come Trent, and Humber, and fayre Thames; Dread Ocean, haste with all thy streames: And if you cannot quench my fire, O drowne both mee and my desire.</i>
From the First Booke of Ayres Part IV (written circa 1613). Accessible on: http://www.luminarium.org/renlit/bravely.htm	<i>Come, chiefest of the British guests, Thou fift of Nouember... Fi'ry Powder hell did make, Which, ready long the flame to take, Lay in shade concealed</i>
Now Winter Nights Enlarge Accessible on: http://www.luminarium.org/renlit/winter.htm	<i>And clouds their stormes discharge Upon the ayrie towres. Let now the chimneys blaze And cups o'erflow with wine, Let well-tun'd words amaze With harmonie diuine. Now yellow waxen lights</i>

Campion is using ‘fire’ as a medium for expressing deep emotion in the quotation from ‘Fire, Fire, Fire!’ but in so doing touches on a point important to the fire protection measures of the day. By the time of the Great Fire in 1666 there were at the Thames water wheels for this purpose [1]²⁷. ‘Squirts’ are mentioned in the discussion of the work of Spenser. An informed imagination can be applied to the importance to fire extinguishment of water from the River Trent at the time Campion was writing. The earliest surviving maps of Nottingham are dated 1609–1610, just about the time Campion made his reference to the Trent [2]. There was coal production in the area, and sale of coal along the river from barges conveying it. The tendency of coal to self-heat when stockpiled would have been well known long before Campion’s time, and for any along the banks of the Trent starting to warm up to be doused with water from the Trent would have been standard procedure. Many of the houses built in Nottingham during the previous century had a timber frame, and thatched residences were common. There was plenty of scope for fire protection from the waters of the Trent by the time Campion wrote ‘Fire, Fire, Fire!’. That he was aware of this is fairly obvious. Similar deductions can be made in relation to the Humber. Hull was a major port then, next only to London and Bristol in movements and vessels [3], so would have had fire control capability comparable to that of the Thames.

In the second quotation from Campion he is writing at a time only of the order of a decade after Gunpowder plot. What he says is analogous to a leader in a newspaper concerned with an event which, using the date of publication of the present book as a baseline in time, occurred in roughly 2000. Whether it was realised then that the gunpowder plot would enter folklore to the (considerably embellished) extent that it did is a matter for debate.

Campion’s ‘Now Winter Nights Enlarge’ has a warm, domestic tone. That coal was available for home use by Campion’s time has been shown in the analysis herein of the work of other authors including Shakespeare. One’s intuition is that Campion was writing of a rural community where wood might have been more likely. The ‘yellow waxen lights’ are of course candles, either tallow or beeswax. That attention is drawn to its being ‘yellow’ is a matter of interest. Probably its colour was less important than the proportion of thermal radiation from the candle which was in the visible region. In today’s world it would be something like a second-year university level calculation to estimate from the temperature of the candle the proportion of radiation emitted by it which is in the visible region. So often instinct predates formal analysis and Campion’s ‘yellow waxen lights’ is probably a case in point.

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21 Sir John Davies (1569–1626)

Work cited	Quotations
The Triumph of Death Accessible on: http://www.poemhunter.com/ poem/from-the-triumph-of-death/	<i>London now smokes with vapors that arise From his foule sweat, himselfe he so bestirres: 'Cast out your dead!' the carcase-carrier cries, Which he by heapes in groundlesse graves interres</i>

The words quoted from 'The Triumph of Death' are too early to refer to the grim realities of the Great Plague of London, which was in 1665. It probably relates to the Black Death ('Cast out your dead' is evidence of that), which was from 1348–1350 [1]. The plague of 1665 was preceded by one in 1563 [1]. It is reported in [2] that incineration of the bodies of plague victims instead of their burial helped restrict spread of the plague. This was a pragmatic measure of the utmost usefulness, though the lack of reverence for the bodies it involved ('heapes in groundlesse graves') is commented upon a little caustically. A sense of duty towards the bodies of the dead rightly continued long after the plague: after World War Two the Commonwealth War Graves Commission was set up.

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22 Thomas Heywood (1570–1641)



Work cited	Quotations
A Woman Killed with Kindness (written 1603).	Act 3 Scene 2. <i>JENKIN: Hark, within there; my master calls to lay more billets upon the fire.</i>

It is pointed out in a footnote to the online version of 'A Woman Killed with Kindness' accessed by the present author that 'billets' simply means small logs. The play is set in rural Yorkshire (Heywood was from Lincolnshire). At the time of the play coal was used in domestic heating in London but not even in *urban* Yorkshire; coal began to arrive in Leeds in the age of the canals, over a century after Heywood's time [1].

Reference

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23 Thomas Dekker (1570–1632)



Work cited	Quotations
The Noble Spanish Soldier (written 1622). Accessible on: http://www.gutenberg.org/cache/epub/16753/pg16753-images.html	<i>MALATEST: This joy to heaven, that bonfires change the night To a high noon, with beams of sparkling flames.</i>
Lust's Dominion (written circa 1600).	<i>ELEAZAR: Shall blow up the old King, consume his Sons, And make all Spain a bonfire.</i> <i>ZARAK: My cock stands perching, like a cock on the game; With a red coal for his crest instead of a comb;</i>
The Shoemaker's Holiday Act 4 Scene 1 (written 1599). Accessible on: http://www.bartleby.com/47/1/41.html	<i>HAMMON: In frostie euenings, a light burning by her, Enduring biting cold;</i>

In Shakespeare's 'Winter Tale', almost exactly contemporaneous with Dekker's 'The Noble Spanish Soldier' the excitement and glamour of the bonfire as a festive event are extolled. Bonfires feature in the earlier work by Dekker in the second column of the table. The availability of coal by the time of this play has been noted, and the vivid metaphor in the second quotation is evidence of how the word had over centuries entered figurative usage. Hammon is lamenting the austere living conditions of a seamstress in whom he has an interest in the quotation from 'The Shoemaker's Holiday', in particular the quite inadequate warmth provided by a (probably tallow) lamp.

24 John Donne (1572–1631)



Work cited	Quotations
<p>Devotions upon Emergent Occasions XXII (written in 1623).</p> <p>Accessible on: https://ebooks.adelaide.edu.au/d/donne/john/devotions/chapter22.html</p>	<p><i>Dost thou look, that I should so look to the fuel or embers of sin, that I never take fire? The whole world is a pile of fagots, upon which we are laid, and (as though there were no other) we are the bellows. Ignorance blows the fire.</i></p> <p><i>...to think that thy present mercy extended to all my future sins, or that there were no embers, no coals, of future sins left in me.</i></p> <p>Several other references to 'coals' in the work by Donne cited.</p>

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<p>Negative Love</p> <p>Accessible on: http://www.luminarium.org/ sevenlit/donne/negative.php</p>	<p><i>For sense and understanding may Know what gives fuel to their fire.</i></p>
<p>Satyre III (written c. 1595).</p> <p>Accessible on: http://www.thinng.net/~grist/ golpub/jdonne/jdonne_f.htm</p>	<p><i>Hast thou couragious fire to thaw the ice Of frozen North discoveries? and thrise Colder then Salamanders, like divine Children in th'oven, fires of Spaine.</i></p>
<p>A Burnt Ship (written between 1590 and 1601).</p>	<p><i>Out of a fired ship, which, by no way But drowning, could be rescued from the flame, Some men leaped forth, and ever as they came Near the foe's ships, did by their shot decay; So all were lost, which in the ship were found, They in the sea being burnt, they in the burnt ship drowned.</i></p>
<p>A dialogue between Sir Henry Wotton and Mr Donne (published posthumously in 1635).</p>	<p><i>As water causeth fire to fret and fume, Till all consume.</i></p>

John Donne in his 'Devotions upon Emergent Occasions' is writing 43 years before the Great Fire of London. By his lifetime England was producing large amounts of coal, most notably in the North East, and this was distributed to ports around the country including London. Donne was a deeply religious man who had drunk from the wells of scripture, and might have been inspired not by contemporary England but by what he had read about 'coals' in the Bible, for example in Romans 12:20 in which case a possible clarification applies. There is no doubt at all that coal in the present sense of the term, describable as mineral coal, was used in Roman times [1]. It is by no means certain that mineral coal was used at the scene of New Testament narratives, and the term in this Pauline usage might have meant charcoal or more generally the carbonised product of some biologically originating substance. In England 'coal' sometimes meant 'charcoal' at times well into the second millennium AD, when the term sea-coal was used to distinguish mineral coal from it. (See also the section on Shakespeare in which this point is discussed in relation to 'Othello').

Even so, Donne had obviously observed for himself the acceleration of coal burning by the use of bellows. He had also seen bundles of wood for fuel use ('fagots'). It was at the time of John Donne that England started to become short of wood fuel [2]. Moreover, depletion of wood through fuel use was seen as potentially jeopardising maritime activity at a time when ships were made from timber. Consequently methods for deep-shaft mining of coal were developed, and these were introduced in the 16th Century in N.E. England and southern Scotland [3]²⁸. This is not a digression: it leads to the important point that Donne's life was at the time of the substitution of coal for wood as fuel in England. That his work was imbued with a consciousness of this is possibly reflected in the fact that both coal and wood appear in the quotation given. Donne was a man of affairs and attuned to economic and social trends.

Mark Twain (1835–1910) is strictly speaking outside the scope of this book as industrialisation was already quite advanced at the time of his birth and intensified over his life span. One might however make the point that his life was at the time of replacement of coal by oil, analogously to the replacement of wood by coal in Donne's day. In neither case was 'replacement' complete. Someone attempting to read the tealeaves in the mid 20th Century might have said that T.S. Eliot's lifetime, which was from 1888 to 1965, would see the transition from chemical energy to nuclear, but in the event there was no real 'transition', only limited use of nuclear fuels in a complementary (sometimes rival) way to conventional. The most recent Nobel Prize for literature went to Patrick Modiano (1945–) [4] whose life has seen the transition to renewables and carbon-neutral fuels. He'd have been 52 years of age at the time the Kyoto Protocol was drawn up. His own country (France) ratified the Kyoto Protocol in 2002.

Returning to John Donne, a point of interest in relation to the quotation from 'Negative Love' is that he did not economise on words by saying instead 'know what fuels the fire' making redundant the commonplace 'gives'. It was in the 1590s according to [5] that 'fuel' as a verb first came into use, so this was either not available to Donne or too novel for his liking. 'Fuel' as a noun can be traced to about 1200 [5].

It is noted in effect twice in the table that it was a very young John Donne who wrote Satyre III. It is uncannily close to the date of writing of the satyre – actually 1583 – that Newfoundland became the first British territory in North America. Donne himself makes reference to Newfoundland in Elegy XX:

*O, my America, my Newfoundland
My kingdom, safest when with one man mannd*

Need more be said in support of the view that Donne's 'frozen North', if it was a composite location in his poetic mind, had been inspired by his having in boyhood become aware of his country's acquisition of Newfoundland, which happened when he was 11 years old? He had a good education by privately hired tutors who would have instilled in the boy a sense of national and international affairs. (His mother was related to Sir Thomas More.) It is known [6] that by the time he was 25 Donne had visited both Italy and 'Spaine' so his reference to the uncomfortably hot weather in the latter was from experience. His comparison to an oven brings that within the scope of this book as all 'ovens' then worked by combustion: there were of course none that worked by electricity.

In 'A Burnt Ship' Donne is making the point that those who stayed on the burning ship and those who jumped overboard suffered the same fatal consequences. The term 'Hobson's choice' – not as sometimes supposed originating from the play of the same name in the 20th Century – owes its existence to an Englishman called Hobson whose lifespan was 1544–1631, so by coincidence he died in the same year that Donne did. It was 'Hobson's choice' whether someone on the ship in Donne's poem remained on it or jumped from it. Donne was writing this at a time when the Spanish Armada was recent news. Fireships were used to good purpose by the English against the Spanish Armada at the Battle of Gravelines in 1588 [7]. These were filled with combustible substances and ignited before being directed at enemy shipping in the (fulfilled) hope that the enemy would assume that the fireships were loaded not with mild combustibles but with gunpowder. Fireships containing gunpowder – termed 'hellebranders' – had been used at the Siege of Antwerp in 1584. All of this would have been known to John Donne. His 'Burnt Ship' is too lacking detail for a deeper comparison to be made, but that he was inspired in particular by use of the fireships at the Armada is a totally reasonable idea. Hellebranders, meaning 'hell's burners', have been termed weapons of mass destruction. Fireships from a totally different period are discussed in the section of the book on Shakespeare. Plate 2 below shows a painting of the use of fireships at Gravelines.



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Plate 2. Fireships at the Battle of Gravelines. Image taken from:
<http://www.britishbattles.com/spanish-war/spanish-armada.htm>

Thomas Lodge (1558–1625) was a contemporary of Donne, and it is noted in the coverage of his work in this book that he had a degree of awareness of how a cupola works. The important side to this is that water on contacting fire need not simply extinguish it but might (to use a term that belongs to a considerably later period) gasify it. In the dialogue with Sir Henry Wotton Donne's 'fret and fume till all consume' is consistent with his having a deeper understanding than the superficial notion that all water can do to fire is put it out.

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25 Ben Jonson (1572–1637)



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<p>The Alchemist (written c. 1610).</p> <p>Accessible on: http://www.gutenberg.org/files/4081/4081-h/4081-h.htm</p>	<p>Act 1 Scene 1.1: <i>FACE: Would make you tinder, but to see a fire; I gave you countenance, credit for your coals, Your stills, your glasses, your materials...</i></p> <p><i>He has his maple block, his silver tongs, Winchester pipes, and fire of Juniper...</i></p> <p>Act 2 Scene 2.1: <i>SIR EPICURE MAMMON: That is his fire-drake, His Lungs, his Zephyrus, he that puffs his coals...</i></p> <p><i>Seeds of them, by our fire, and gold in them; And can produce the species of each metal...</i></p> <p>Act 3 Scene 3.1: <i>SUBTLE: We must now increase Our fire to ignis ardens; we are past ...balnei, cineris.</i></p> <p>The above is a carefully chosen selection. There are many other references to 'fire' in the play.</p>
The Forest (written. c. 1616).	<i>And with the flame Of love be bright, As with the light Of bonfires ! then The birth-day shines, when logs not burn, but men.</i>
Epicoene (first performed 1609).	<i>From Act III. MISTRESS OTTER: A third time, at the lord's masque, it dropt all my wire and my ruff with wax candle, that I could not go up to the banquet.</i>

'Face' is a housekeeper whose comments quoted in the table are directed to the alchemist whose name is Subtle. Face was aware that Subtle used Juniper wood as a fuel. Francis Bacon, who has a section to himself elsewhere in this book and whose life overlapped with that of Ben Jonson, described Juniper as a 'wood odorate [that] maketh a hot fire'²⁹. That Subtle, like other alchemists, also used coal as a fuel had obviously been observed by Face. A fixed bed of coal requiring air for accelerated burning can be supplied with air by a compressor, by now a time-honoured process. Sir Epicure Mammon was obviously aware that at that time, and on the scale on which an alchemist works, this was done by supply of air from the alchemist's own lungs. A glassblower to this day will do this, not to primarily to aerate a flame but to direct it. Mammon's use of the term Zephyrus is interesting. The word in mythology means the god of wind [1]. Subtle's own statement quoted can be analysed as follows. 'Ignis ardens' simply means 'burning fire'. 'Balnei' means 'bath'. 'Ceneris' means 'soot'. So this statement is plentiful in terms relating to the combustion side of the alchemist's art.

Jonson's 'The Forest' is one of his several poems and his mention of bonfires merits examination. It is perhaps not insignificant that Jonson wrote that a mere decade after the Gunpowder plot (see also the section on Shakespeare, in which 'Macbeth' is discussed)³⁰. However, the bonfire as a form of social event long predates that (e.g. [2]) and often has a ritual dimension. The reference by Mistress Otter to the wax candle in the quotation from Epicoene is highly significant, as she distinguishes a beeswax candle from a tallow candle. This is entirely consistent with the opulence of the circumstances, which she describes in the same passage.

References

- [1] <http://www.theoi.com/Titan/AnemosZephyros.html>
- [2] Ebeling J.R. 'Women's Lives in Biblical Times' Bloomsbury Publishing (2010).

26 Thomas Coryat (1577–1617)



Work cited	Quotations
<p>Coryat's Crudities: Hastily gobled up in Five Moneth's Travels (a travelogue published in 1611).</p> <p>Accessible on: http://www.archive.org/stream/coryatscrudities01coryuoft/coryatscrudities01coryuoft_djvu.txt</p>	<p><i>Attila King of the Hunnes, when he came out of Pannonia into Italy, with an exceeding huge armie, Anno 457. and in the third yeare of the Emperour Martianus, was the first that sacked it...</i></p> <p><i>About one hundred and eighty yeares after that time Egilolphus the fourth King of the Longobardes wasted Padua wasted it with most extreme cruelty. And whereas after hee had burnt some part of it, the citizens yeelded themselves into his handes, hoping that we would have saved the rest: the barbarous tyrant though he spared the lives of the inhabitants, was so furiously enraged against the citie it selfe that he consumed with the mercilesse force of the fire almost all the rest of the buildings that remained in the citie. Then it was reedified by Charlemaigne about the yeare 774. From that time it enjoyed peace for the space of almost foure hundred yeares, till the time of Fridericus Barbarossa, who oppugned it with great fury, Frederick and defaced a great part of it about the yeare 1170.</i></p> <p><i>...the love of Odcombe in Somersetshire, which is so deare unto me that I preferre the very smoke thereof before the fire of all other places under the Sunne.</i></p>

In the first quotation Coryat is talking about events in the places he had travelled to, but which had taken place at times earlier by the order of a millennium. The burning of towns features frequently, and these can be checked against other sources. The doings of 'Attila the Hun' have been the subject of much prose and poetry writing. The present author's online research has shown fairly conclusively that the year AD 457 for the burning of Pannonia is open to question. In fact it appears to be widely believed that he died in AD 453 [1]. An authoritative source [2] gives AD 451 for the burning of Pannonia. The same source says that the Huns 'gave the city to flames'. The rest of the quotation has the theme of destroying places by fire. Remarkably, a journal article originating in Canada in 1917 giving accounts of the War in Europe is entitled 'Burning oil for the Huns' and describes the very effective use of burning oil. One can only imagine that the author of the piece was invoking 'The Huns' in the title with reference to Attila and probably to Pannonia. Oils of animal origin would have been used by the Huns in 451. It is much more likely that that used in France in 1917 was of petroleum origin.

In the last of the quotations Coryat is saying that in spite of the interest and pleasures of his travels he would only ever want to reside long term in his home town of Odcombe in Somerset. Probably coal delivered by sea to the Bristol Channel (as did happen) was used in Odcombe as a domestic fuel at that time, and Coryat's nostalgia for the 'smoke' of Odcombe is partly a result of that.

References

- [1] https://www.google.com.au/?gfe_rd=cr&ei=fu0SVujtMczu8wf-m52YBg&gws_rd=ssl#q=attila+the+hun+death
- [2] Harvey B.C. 'Attila, the Hun' Infobase Publishing (2003).



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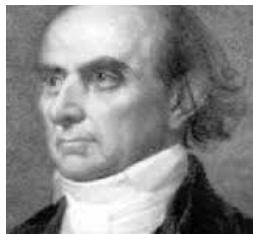
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27 John Webster (1578–1632)



Work cited	Quotations
The White Devil (first performed 1612).	Act 1, Scene 2. <i>FLAMINEO: ...which like the fire at the glass-house hath not gone out this seven years</i> From the rubric to Act 2, Scene 2: ...‘and then burn perfumes before the picture, and wash the lips of the picture; that done, quenching the fire, and putting off their spectacles, they depart laughing’ Act 2, Scene 1. <i>FRANCISCO DE MEDICIS: Make fireworks like their father?</i>
The Duchess of Malfi (first performed 1614). Accessible on: http://www.gutenberg.org/ files/2232/2232-h/2232-h.htm	Act 1, Scene 2. <i>FERDINAND: Why do you laugh? Methinks you that are courtiers should be my touch-wood, take fire when I give fire;</i> Act 2, Scene 1. <i>FERDINAND: I would have their bodies Burnt in a coal-pit with the vantage stopp'd That their curs'd smoke might not ascend to heaven</i> Based on events in the early 16 th Century.

The glass-house is of course a place of glass manufacturing, such as is referred to in the discussion of ‘Paradise Lost’. Two points in relation to Webster’s reference to glass manufacture can be made. One is that there were several ‘glass-houses’ in London at the time he wrote the play. The other points is that it was in about 1600 that coal replaced wood at the ‘glass-houses’ of London [1]. The expression ‘burn perfume’ has a point of contact with a word not coined until the 20th Century, ‘aromatherapy’. The 16th century was a period of major interest in activity into fragrances and interestingly the word perfume is derived from ‘fumare’, to smoke [2]. This reflects the fact that release of a fragrant agent from a plant or herb requires heat. The Online Etymology Dictionary states that ‘perfume’ dates from the 1530s. So both in glass and in perfume Webster was making up-to-date references to the activity of his times. Pyrotechnics of course long predate Webster’s time, and the mention of fireworks *per se* is not of great interest. What is interesting and possibly relevant is that in the years of Webster’s boyhood, which were spent in London, Queen Elizabeth I used to hold fireworks displays on the Thames [3].

‘Touch-wood’ (following row) has a fairly obvious meaning, which incidentally has been referred in accounts of the life of Martin Luther [4] whose lifetime was 1483–1546. Moving on to the second quotation from ‘The Duchess of Malfi’, probably bellows had been used in vantage (ventilation) at scenes of coal production by the time of the setting of the play, so the barbarous suggestion, obviously having fatal consequences if implemented, being made is that operation of these by human hands or feet be ‘stopp’d’.

Reference

- [1] <http://www.glassmaking-in-london.co.uk/fitzwilliam/chapter1>
- [2] Ó Muiríthe D. ‘Words We Use: The Meaning of Words And Where They Come From’ Gill and Macmillan (2006).
- [3] <http://theconversation.com/a-history-of-fireworks-how-about-some-flaming-artichokes-to-blast-in-the-new-year-33751>
- [4] The Christian Spectator, Volume 3 Howe and Spalding (1821).

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28 Thomas Middleton (1580–1627)



Work cited	Quotations
Women Beware Women (written c. 1620). Accessible on: https://archive.org/stream/WomenBewareWomen/WomenBewareWomen_djvu.txt	Act 1 Scene 1. <i>SORDIDO: Yes, sir; your cats are always safe i' th' chimney corner, Unless they burn their coats.</i> <i>Act 4 Scene 1.</i> <i>LORD CARDINAL: To take a burning taper, 'tis no wrong...</i>
A Chaste Maid in Cheapside (written 1613) Act 1 Scene 2. Accessible on: http://www.tech.org/~cleary/chast.html	<i>MR. ALLWIT: Find excellent cheer, a good fire in winter, Look in my coal house about midsummer eve,</i> <i>That's full, five or six chaldron, new laid up.</i>
Hengist, King of Kent (written c. 1619) Accessible on: http://www.tech.org/~cleary/hengist.html	Act 5 Scene 1. <i>SIMON: Bonfires of pease-straw burn; let the bells ring.</i> Act 5 Scene 2. <i>AURELIUS: So fortify'd? Let wildfire ruin it, That his destruction may appear to him...</i> Play set in the 5 th century AD.
The Witch (written c. 1609) Act 5 Scene 2. Accessible on: http://www.tech.org/~cleary/witch.html	<i>His picture made in wax and gently molten By a blue fire kindled with dead men's eyes Will waste him by degrees.</i>
The Puritan (written 1606). Accessible on: http://www.tech.org/~cleary/purit.html	Act 1 Scene 4. <i>PYEBOARD: ...though 'twere hid under a mine of sea-coal and ne'er make spade or pick-axe his instruments.</i> Act 2 Scene 1. <i>PYEBOARD: ...wherein he is like to remain till the dissolution of the world, till the last general bonfire</i>
The Revenger's Tragedy Accessible on: http://www.tech.org/~cleary/reven.html	<i>Hell would look like a lord's great kitchen without fire in't!</i>

Anyone who has ever owned a domestic cat knows that such an animal has a very sharp eye for its own comfort, and this is recognised in the first quotation in the table above. The matter of ‘burning’ their coats is a scientifically interesting one; ‘burn’ probably meant ‘discolour’. A cat’s ‘coat’ contains large amounts of the fibre protein keratin, decomposition of which on mild heating causes colour changes. The recumbent cats in ‘Women Beware Women’ would have needed to be nowhere near the pain threshold for that to happen on lengthy exposure to heat from ‘th’ chimney corner’. Wool also contains keratin, and there have been heavy financial losses when a shipment of wool has, through mild spontaneous heating, lost its colour during a voyage. The mildness of the thermal effect on the voyage was such that the occupants of the vessel did not suspect by sense of smell or in any other way that anything was amiss. In early 1900s New Zealand, where there was heavy reliance on exported wool for revenue, the seriousness of this was such that a Royal Commission was convened to look into it. Much later a formal investigation was carried at the Dominion Laboratory in Wellington.

In the discussion herein of the work of Shakespeare (a contemporary of Middleton) it is pointed out that a candle at that time would have been made of beeswax or of tallow. The ‘burning taper’ can perhaps be analysed along these lines. That tapers, in the sense that the term is now understood, were available long before Middleton’s time is certain.

One can take a little further the matter of protection of the cats from the heat from the chimney. If they were close to the masonry or whatever comprising the ‘chimney corner’ without touching it they’d have been receiving heat by natural convection, an inherently weaker phenomenon than conduction. They would have received heat by conduction if parts of their bodies were touching the chimney corner. So Sordido would have seen it necessary to shoo the cats away from direct physical contact with the chimney structure but would have had no concern if they were close to it without contacting it. In a more modern and less homely paradigm, it is the intrinsically stronger character of conduction over convection that makes it possible to burn with ease ‘rubbishy’ fuels like meat works waste in a fluidised bed.

Moving on to ‘A Chaste Maid in Cheapside’, use of coal in London as a domestic fuel in the early 17th Century is very plainly confirmed. The fact that the ‘coal house’ was full in midsummer is easily explained. The coal had been purchased at a discount in summer for use the following winter. Both parties in such a deal won: the consumer got the coal cheaply and the coal merchant freed up some valuable storage space. The ‘chaldron’ was about 2 tonnes³¹. So if Mr. Allwit’s coal house in ‘A Chaste Maid in Cheapside’ held six chaldrons and was cubic in shape it would have needed to be about 2.5m × 2.5m × 2.5m. This is on the basis of 900 kg m⁻³ for the bulk density of the coal. Further simple calculations follow.

At the present time it is considered that about 100 W per m² of internal surface area are needed to heat a room in the English winter. Using a value of 40 MJ kg⁻¹ and 300 m² for the area (an estimate for one of the larger rooms in a plush residence) coal of calorific value 30 MJ kg⁻¹ would have heated the room for a time 't' seconds, featuring in the equation below.

$$2000 \times 6 \text{ kg} \times 30 \times 10^6 \text{ J} = 300 \text{ m}^2 \times 100 \text{ W m}^{-2} \times t \text{ s}$$

↓

$$t = 1.2 \times 10^7 \text{ s or 20 weeks}$$

or, perhaps more helpfully, three such rooms for about 13 weeks (about the duration of an English winter) if the fire was kept going for 12 hours each day. These figures signify planning in the size of the coal storage space.

It was only shortly after Middleton's time that the 'trade card' came into wide use. Plate 3 below one for a London coal merchant in the late 17th Century. Note the image of removal from sailing ships to barges to horse-drawn conveyances.

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Plate 3. Late 17th Century trade card for a London Coal merchant. Image taken from:

https://www.google.com.au/search?q=trade+card+coal+merchant&biw=1297&bih=691&source=lnms&tbo=isch&sa=X&ved=0ahUKEwjXkvLL38PJAhUD5KYKHZLAmAQ_AUIBigB#imgrc=Wuni0xwE4HIFRM%3A

Turning to 'Hengist, King of Kent', having regard to the period of the play the 'bonfire' is making its earliest appearance amongst the pieces of literature analysed. Pease-straw simply means (as one would infer) the residue from growing peas. That Malory amongst others also used 'wildfire' has been noted. In considering the reference to a blue flame in 'The Witch' by Middleton it has to be remembered that he would not have seen the 'blue flame' familiar from the late 19th Century onwards on a burner for coal gas. What might have been observed by Middleton was a blue flame resulting from ignition of a fermented liquor: approximately speaking (etymologies are often not clear-cut) 'brandy' means 'burned water' [1] and a century before Middleton's time it was a well known that brandy could be ignited and that the resulting flame was pale blue. (Lighting the rum on a Christmas pudding is of course a further example of this.) That is at least as plausible an explanation as his having observed distilled liquor above its flash point! 'The Puritan' (following row), interestingly and significantly, contains two points noted several times previously in this book: sea-coal as a staple fuel at the period and the bonfire as a form of festivity. Notes in the edition of 'The Revenger's Tragedy' give as an interpretation of the quotation cited: 'Without gold and women, there would be no fuel for the fires of hell, which would then resemble the kitchen of a great house without its huge open fires, steam and smoke.'

References

[1] http://self.gutenberg.org/articles/distilled_liquor

29 John Smith (1580–1631)



Work cited	Quotations
<p>A Description of New England (written 1616, after Smith had visited Massachusetts and Maine).</p> <p>Accessible as the pdf file:</p> <p>P. Royster (Ed.) 'A Description of New England (1616) John Smith, Captain & Admiral' Electronic Texts in American Studies, University of Nebraska – Lincoln.</p>	<p><i>Wood, Flax, Pitch, Tarre, Rosin, Cordage, and such Like...</i></p> <p>Other references to pitch and 'tarre' in the book.</p> <p><i>Oke, is the chiefe wood; of which there is great difference in regard of the soyle where it groweth. Firre, pyne, walnut, chesnut, birch, ash, elme, cypresse, ceder, mulberrie, plumtree, hazell, saxefrage, and many other sorts.</i></p> <p><i>...and that they were entertained to fish, and not to fight: vntill the Captaine vowed to fire the powder and split the ship, if they would not stand to their defence; whereby at last wee went cleere of them, for all their shot.</i></p>

'Pitch' has featured elsewhere in this book as belonging to a period considerably before John Smith's treatise, as has 'flax'. Here pitch probably means a breakdown product of wood rather than the substance found, for example, at La Brea in Trinidad. 'Rosin' is a substance from the thermal breakdown of wood as in this context is 'tarre'. The vessel in which Smith himself travelled across to the US would have been waterproofed with substances like these, a fact of which he would certainly not have been unaware. As a point of historical interest, Sir Walter Raleigh discovered the pitch reserve in Trinidad about 20 years before the time of Smith's book and himself used it as a ship protectant before embarking upon the next stage of his travels. The next quotation in the table reflects Smith's interest in arboriculture. The next one describes an altercation with 'French Pyrats' and it is clear that the gunpowder which Smith and his shipmates were carrying had stood them in good stead.

30 Robert Herrick (1591–1674)



Work cited	Quotations
<p>Ceremonies For Christmas</p> <p>Accessible on: http://www.poemhunter.com/ robert-herrick/poems/</p>	<p><i>Come, bring with a noise, My merry, merry boys, The Christmas log to the firing, While my good dame, she Bids ye all be free, And drink to your heart's desiring.</i></p> <p><i>...that sweet luck may Come while the log is a-tinding.</i></p>
<p>The Ceremonies For Candlemas Day</p> <p>Accessible on: http://www.poemhunter.com/ robert-herrick/poems/</p>	<p><i>Kindle the Christmas brand, and then Till sunset let it burn; Which quench'd, then lay it up again, Till Christmas next return.</i></p> <p><i>Part must be kept, wherewith to teend The Christmas log next year; And where 'tis safely kept, the fiend Can do no mischief there.</i></p>

The custom of burning logs at Christmas is mentioned in the discussion of the work of Henry Fielding, who is about a century later than Herrick. The theme of that – and of liturgical candle burning – recurs in ‘The Ceremonies For Candlemas Day’. This was at a period in history when the Christian calendar was also the social calendar and formed the structure of successive years.

31 Thomas Carew (1595–1640)



Work cited	Quotations
The Spark. Accessible on: https://archive.org/stream/poeticalworksth00jonegoog/poeticalworksth00jonegoog_djvu.txt	<i>He needs must wander that hath lost his way. Guiltless I am: she did this change provoke. And made that charcoal which at first was oak.</i>
The Unfading Beauty Accessible on: http://www.poemhunter.com/poem/the-unfading-beauty/	<i>He that loves a rosy cheek, Or a coral lip admires, Or from star-like eyes doth seek Fuel to maintain his fires: As old Time makes these decay, So his flames must waste away.</i>
Song: Eternity of Love Protested.	<i>But doth at once, like paper set on fire, Burn and expire.</i>



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There have been references to charcoal in other parts of this book in the discussions of Spenser's work and of Donne's. A little more than a further example of repetition of this can be made in relation to Carew's reference to it if one accepts the hypothesis that there is a hint that an oak tree having been made into a mundane substance like charcoal had been *diminished*. An oak tree then and much more recently was seen as an asset, a natural work of art. There is in Bowthorpe Lincolnshire, England an oak tree known to predate the Norman Conquest [1]³². For that to have been felled to make charcoal in Carew's day would have robbed subsequent generations of a piece of grandeur. This argument is not negated if in fact Carew's use of the terms oak and charcoal was figurative. In the quotation from 'The Unfading Beauty' in the second row, Carew has anticipated an expression now, in the 21st Century, widely used in fire protection engineering. When a fire is decreasing in heat release because of fuel depletion it is said to have entered the decay stage or decay phase.

The rapid burning of paper had been observed by Carew, an effect which a present-day combustion expert would attribute to its 'thermal thinness'. 'Expire' suggests total loss: wood would under common combustion conditions leave behind some char. One would not, at the time Carew wrote that, want to burn too much paper anyway: locally made paper in England at that time was scarce and paper had to be imported sparingly from Europe, in particular from France [2]. This state of affairs was to continue throughout the 17th Century.

References

- [1] <http://www.theguardian.com/travel/2011/apr/09/ancient-trees>
- [2] <http://www.wovepaper.co.uk/background.html>

32 Martin Parker (1600–1656)

Work cited	Quotations
<p>A True Tale of Robin Hood a.k.a. Child's Ballad 154 (written c. 1630). Accessible on: http://www.sacred-texts.com/neu/eng/child/ch154.htm</p>	<p>From a modern commentary by S. Knight and T.H. Ohlgren accessible on: http://d.lib.rochester.edu/teams/text/robin-hood-and-his-crew-of-souldiers-introduction <i>...robbery, burning of houses, felony, waste and spoile</i> Set in the reign of King Richard I (1157–1199).</p>

Authorship of the Robin Hood tales is a little muddled because of re-writes³³, but attribution of them to Martin Parker, whose lifetime places him within the scope of this book, is not inappropriate provided that it is backed up with some further information. The quotation re burning of houses is due not to Parker but Sir Edward Coke (1552–1634) whose life overlapped with that of Parker. Parker was a balladist, Coke a historical investigator. Coke was resolved to establish the role in English life of Robin Hood during the reign of King Richard and record some of his doings [1]. It was in the 12th Century – the time of Robin Hood if his acquaintance with King Richard is to be believed – that accidental fires in timber homes became so rife that an ordinance was passed to the effect that new houses had to have one wall made of stone, to provide what we'd now call passive fire protection [2]. In discussion of Shakespeare's Sonnet XII the matter of carbon dioxide sequestration by trees is raised. In 'Ballad 154' Robin Hood's forest abode is strongly emphasised. The forest dweller at that period would have lit fires for heating and cooking by means of a fire plow [3]. This involves rubbing a soft piece of wood with a harder one creating wood dust which, with further friction, ignites and smoulders. Blowing on that generates a flame which can be used as an ignition source.

Reference

- [1] Potter L. 'Playing Robin Hood: The Legend as Performance in Five Centuries' University of Delaware Press (1998).
- [2] Ley A.J. 'A History of Building Control in England and Wales 1840–1990' RICS Books (2000) (Mention of 12th Century houses *en passant.*)
- [3] <http://adventure.howstuffworks.com/survival/wilderness/how-to-start-a-fire3.htm>

33 Thomas Browne (1605–1682)



Work cited	Quotations
<p>Hydriotaphia, Urn Burial (published 1658).</p> <p>Accessible on: http://penelope.uchicago.edu/ hydrionoframes/hydron.html</p>	<p><i>Numerous references to combustion with reference to remains from funeral pyres, including:</i></p> <p>Chapter II: <i>Some [urns] containing two pounds of bones, distinguishable in skulls, ribs, jaws, thigh-bones, and teeth, with fresh impressions of their combustion.</i></p> <p>Chapter III: <i>...the body compleated proves a combustible lump, wherein fire findes flame even from bones, and some fuell almost from all parts.</i></p> <p>Chapter IV: <i>That they kindled not fire in their houses for some days after [a funeral pyre], was a strict memorall of the late afflicting fire.</i></p> <p>Written after the discovery of a few dozen urns in Norfolk and a study of their contents. Elements of what was to become forensic science can be traced.</p>
<p>Religio Medici (published 1645).</p>	<p><i>...and thus would hee inveagle my belief to thinke the combustion of Sodome might be naturall, and that there was an Asphaltick and Bituminous nature in that lake before the fire of Gomorrha:</i></p> <p><i>Philosophers that opinioned the worlds destruction by fire, did never dreame of annihilation, which is beyond the power of sublunary causes; for the last and proper action of that element is but vitrification, or a reduction of a body into glasse; and therefore some of our Chymicks facetiously affirm, that at the last fire all shall be crystallized and reverberated into glasse, which is the utmost action of that element.</i></p>

With reference to incipient forensic science in the shaded area in the first row of the table we note that Browne's *Hydriotaphia* (frequently referred to as an 'essay') was written during the lifetime of Isaac Newton, at a time when science was influencing 'thought' and, of course, vice versa. Browne was medically trained. 'Religion Medici' (following row) significantly predates 'Hydriotaphia' and is the work for which Browne is most noted. To the combustion expert his reference to an 'Asphaltick and Bituminous nature' is of deep interest and significance. In today's world 'asphaltenes' are derived from crude oil; clearly the earlier, related term asphlatick had its origin in some naturally occurring hydrocarbon. We are informed in [1] that by the 14th Century the term 'asphalt' meant a viscous liquid from pitch. There were no 'pitch lakes' in England, but pitch was imported into England from the Baltic region at that time for use in ship building [2]. That might have been the origin of Browne's awareness of the substance, although there is another possible explanation. The world's most famous pitch lake is that at La Brea in Trinidad, still a tourist attraction. It was discovered in 1595, ten years before Browne's birth by which time there was a British component to the population of Trinidad. Bitumen was a synonym for asphalt in Browne's time. Nowadays equivalent substances would be obtained from the heavy 'ends' of crude oil. The term bitumen carried over in the 19th Century to coal science, 'bituminous coals'.

Moving to the next quotation from *Religio Medici*, Browne is asserting the indestructibility of matter by fire and what he says presages very clearly the Law of Mass Conservation which was first formally expressed a little over a century later by the Russian scientist³⁴ Mikhail Lomonosov [3].

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34 John Milton (1608–1674)



Quotations from 'Paradise Lost', first published 1667³⁵ and divided into 'Books'.

↓

From Book 1.

*There stood a Hill not far whose griesly top
Belch'd fire and rowling smoak...*

*As one great furnace flamed, yet from those flames
No light, but rather darkness visible.*

*...whose combustible
And fewel'd entrals thence conceiving Fire...*

Many more references to fire in Book 1 and throughout the entire work.

From Book 2.

Black fire and horror shot with equal rage...

*So wide they stood, and like a furnace-mouth
Cast forth redounding smoke and ruddy flame.*

From Book 3.

With radiant light, as glowing iron with fire...

From Book 4.

*the smutty grain,
With sudden blaze diffused, inflames the air...*

From Book 5.

*Of sooty coal the empiric alchemist
Can turn, or holds it possible to turn*

From Book 6.

But rattling storm of arrows barbed with fire...

From Book 9.

O'er the blue firmament a radiant white...

From Book 10.

Which might supply the sun: Such fire to use...

From Book 11.

*Love's harbinger, appeared; then, all in heat
They light the nuptial torch...*

From Book 12.

*...then raise
From the conflagrant mass, purged and refined...*

The above are a number of references to fire and burning from the many in 'Paradise lost'. Considering the first quotation in the table, a version of Book 1 with 'modernised spelling' [1] gives 'griesly' as 'grisly', 'rowling' as 'rolling' and (of course) 'smoak' as 'smoke'. The poem is mythology, and to relate it to a topic like combustion science which is firmly rooted in the physical sciences is a formidable challenge. Yet what medium of expression other than instincts and observations common to all humankind has a writer of mythology got? 'Rolling smoke' is an example. The 'rolling' of smoke, which Milton would have observed for himself³⁶, is due to the interplay of two factors: natural buoyancy because the smoke is hotter than the air it is entering, and currents in the cold air. In other words, it is the resultant of natural and forced convection. Quantitative analyses of these phenomena began with F. Grashof (b. Germany 1826) and was continued by W. Nusselt (b. Germany 1882). 'Furnace' (following quotation from Book 1) was a word in use in Chaucer's time as previously noted³⁷. Very interesting is use of the word 'combustible' in the next quotation, which is not taken from a modernised form. We are informed in [2] that the word originates from about 1520. It is very widely used today whereas the verb form 'to combust' is not universally approved in the 21st Century. The Combustion Institute, a very powerful body, was indecisive over this issue in the final quarter of the 20th Century. Note 'fewel' (fuel) in the verb form in the quotation from Milton. It was noted in the part of the book on John Donne that 'fuel' as a verb came into use only in the 1590s.

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The ‘modernised spelling’ version has been used in the quotations from Book 2. ‘Black fire’ is an expression entirely consistent with Milton’s own time. It was pointed out in the discussion of the writings of Sir Francis Bacon that at that time there was no means of pre-mixing air and fuel for combustion: that came much later, notably with the invention of the Bunsen burner the principles of which carried through to the gas cooktop burner of today. Non- premixedness (a recognised and widely used term in modern combustion science) led to incomplete combustion and therefore a smoky flame. Milton’s ‘black fire’ is reminiscent of this. ‘Furnace’ appears again in Book 2. Having regard to the fact that he was writing in the pre-industrial era, what ‘furnaces’ were there in his day? Glass production at that time and earlier did use a furnace, and it was in Milton’s lifetime that coal replaced wood in such furnaces³⁸. Fairly obviously he had either seen such a furnace or had had one described to him. ‘Redounding smoke’ is probably a reference to the absence of a smoke extraction system. (There is further consideration of glass production when the work of John Webster is considered.)

‘Radiant light’ is an interestingly prophetic statement: heat so transferred *is* radiative, not convective or conductive. That as a discovery in physics did not of course come until much later. The ‘smutty grain’ and its inflammation of air (Book 4) leaves the exegete with a considerable difficulty: a conjectural analysis will be given. By Milton’s time ‘subterranean’ [3] coal mining had come into being in England and it was as dangerous a way of earning a living as could be imagined. ‘Smut’ meaning dirty particles suspended in air came into usage just at the time that Milton was writing ‘Paradise Lost’ so he was using a trendy term (and why shouldn’t he?). In those days of extremely hazardous coal winning dust explosions were a common cause of death amongst miners, as they were to be for centuries. Milton would have read in such periodicals as the ‘London Gazette’ of such tragedies. What better, in the English language of the time, describes a coal dust explosion than ‘the smutty grain, with sudden blaze diffused, inflames the air’. The similarity is remarkable, even though Miltonian scholars might of course have other interpretations of this expression. Use of contemporary terms in mythological writing is a totally legitimate technique. ‘Arrows barbed with fire’ (Book 6), if the term is taken to be synonymous with ‘fire arrow’, were part of the English armoury of Milton’s own time and were used in the Civil War [4], the dates for which are 1642–1651. They often contained gunpowder so were explosive. Those with solely an incendiary role were sometimes aimed at thatched houses. This would have been known to Milton.

It is perhaps possible to read a little into ‘radiant white’, a term used in Book 9. At the time Milton wrote that Isaac Newton’s splitting of white light into its constituent colours by means of a prism was in the fairly recent past.

With reference the ‘the sun’ and ‘fire’ in Book 10, it is difficult to know whether Milton was being poetic or at least attempting to be factual. He could not possibly have known about nuclear fusion, and the notion that the sun is a combustion process was not finally seen off for good until the late 19th century [5]^{39,40}. So here Milton was a victim of the paucity of knowledge of his day. The nuptial torch (Book 11) would feature in a Roman wedding, and there would be torches at funerals in those times. Pine wood was a common choice of fuel [6]. Milton’s earliest education at St. Paul’s School in London involved specialism in Greek, Latin and Theology. ‘Conflagrant mass’ (Book 12) has become a term largely associated with Milton although he did not, of course, coin ‘conflagrant’.

Paradise Regained (published in 1671) has a dearth of content relevant to the present text. In fact the only suitable quotation is the self-explanatory:

He found his supper on the coals prepared.

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- [4] Lawrence D. ‘The Complete Soldier: Military Books and Military Culture in Early Stuart England, 1603–1645’ Brill NV Leiden (2008).
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35 Sir John Suckling (1609–1641)



Work cited	Quotations
Orsames' song in Aglaura (play first staged 1637)	<p><i>That you can figure to yourself a fire</i> <i>Void of all heat, a love without desire.</i></p> <p>Also from Aglaura ↓</p> <p><i>Torches shall burn bright, so bright that they shall</i> <i>dim the light of al that went before.</i></p>

The figure of speech 'fire void of all heat' can be formally described in several ways. One is oxymoron, a term first coined at about the time of Suckling [1] though having an etymology traceable much further back than that. A logician would classify the statement as a 'formal fallacy', as good a term as any. It has to be remembered however that poetry by its nature is not intended to be wholly amenable to the techniques of logic as a discipline. In fact the term 'fire void of all heat' can be compared with Milton's 'darkness visible' written thirty years later.

Plain hyperbole is evident in the second part of the italicised statement in the table, but in the first part of it there is a point suitable for technical analysis. The 'torches' provision for which is made in the rubric, would probably have been flambeaux or devices resembling them. Flambeaux are discussed in this book in relation to Lady Mary Wortley Montagu, who was a generation later than Suckling.

36 James Harrington (1611–1677)



Work cited	Quotations
<p>The Commonwealth of Oceana (published 1656). Accessible online in pdf form.</p>	<p><i>A whole army, though they can neither write nor read, are not afraid of a platform, which they know is but earth or stone; nor of a cannon, which, without a hand to give fire to it, is but cold iron;</i></p> <p><i>And forasmuch as sovereign power is a necessary but a formidable creature, not unlike the powder which (as you are soldiers) is at once your safety and your danger, being subject to take fire against you as well as for you, how well and securely is she, by your galaxies so collected as to be in full force and vigor and yet so distributed that it is impossible you should be blown up by your own magazine?</i></p> <p><i>... and I shall be laughed at, for assuring you, that it is nothing else but such a damp (continued by the neighborhood of certain sulphur mines) as through accidental heat does sometimes happen in our coalpits.</i></p>

The first quote from 'The Commonwealth of Oceana' has the theme that a cannon without the agent which makes it work and the expertise to operate it is no threat to anyone ('but cold iron'). Gunpowder dominates the second quote. It is remarkable that the words 'blown up by your own magazine' were published one year before precisely that happened to a Spanish vessel as described in a poem by Andre Marvell *q.v.* An inference is that it was not an uncommon occurrence in naval conflict. The 'accidental heat' in the coal mines is of course leaked methane. The present author would not care to attempt to be too precise about how many coal miners have lost their lives to this over the centuries, but hundreds of thousands is an intuitive lower bound on the order of magnitude. It continues into the 21st Century. Reference to 'a damp' in Harrington's work is interesting: methane in coal mines became known as 'firedamp'.

37 Anne Bradstreet (1612–1672)⁴¹



Work cited	Quotations
Here Follows Some Verses upon the Burning of Our House (written 1666). Accessible on: http://www.poetryfoundation.org/poem/172963	<i>That fearful sound of 'fire' and 'fire' Let no man know is my Desire...</i> <i>Then, coming out, behold a space The flame consume my dwelling place.</i>

The poem narrates a true event: the Bradstreets' home in North Andover Massachusetts did burn down on July 10th 1666 [1]. The Bradstreets were very influential people in Massachusetts, playing for example a major role in the founding of Harvard University. Many illustrious Londoners were to lose their elegant homes to fire just 54 days later when the Great Fire began there.

Reference

[1] <http://www.poemhunter.com/anne-bradstreet/biography/>

38 Samuel Butler (1613–1680)



Work cited	Quotations
<p>Hudibras (written in three volumes over the period 1663 to 1678). Accessible on: http://www.gutenberg.org/cache/epub/4937/pg4937-images.html</p>	<p><i>Love is a fire, that burns and sparkles In men as nat'rally as in charcoals, Which sooty chymists stop in holes When out of wood they extract coals:</i></p> <p><i>Which now began to rage and burn as Implacably as flame in furnace...</i></p>

The first quotation taken from Hudibras is fairly obviously a description of the established means of making charcoal from wood, allegorised to express an emotional phenomenon. This work is contemporary with Milton's 'Paradise Lost', in which as noted 'furnace' is also used.

39 Richard Lovelace (1617–1657)



Work cited	Quotations
The Grasshopper (written 1649).	<i>Our sacred hearths shall burn eternally, As vestal flames; the North Wind, he Shall strike his frost-stretched wings, dissolve, and fly...</i>

'Vestal flames' refers of course to Ancient Rome; they were historical (commencing circa 700 BC) not mythological so are 'authentic combustion'. The task of keeping them alight was fulfilled by the Vestal Virgins and the fuel was wood [1]. Lovelace is linking them to much more recent times. The 'Vestal Virgins' have so often tended to feature in the arts, for example, in the 1967 pop song 'A Whiter Shade of Pale' by Procol Harum.

Reference

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40 Abraham Cowley (1618–1667)



Work cited	Quotations
The poem 'Sport', reproduced in full in the adjacent column.	<p><i>The merry waves dance up and down, and play, Sport is granted to the sea; Birds are the choristers of the empty air, Sport is never wanting there.</i></p> <p><i>The ground doth smile at the spring's flowery birth, Sport is granted to the earth; The fire its cheering flame on high doth rear, Sport is never wanting there,</i></p> <p><i>If all the elements, the earth, the sea, Air, and fire, so merry be, Why is man's mirth so seldom and so small, Who is compounded of them all?</i></p>

In the analysis herein of 'Sport' three facts which possibly intersect will be given. In 1612 the first 'Cotswolds Olympick Games' were held, and continue to the present day [1]. They had their origins in the ancient Greek Olympics but did not replace or continue them as did the first 'Modern Olympic Games' in 1896. Abraham Cowley was a member of the Great Tew circle of writers (as was Ben Jonson *q.v.*) [2] who met at a manor in Great Tew, in the Cotswolds. Cowley would have known of the Cotswolds Olympicks and, whether it had a symbolic torch or not, would have been aware that the ancient Olympics by which it was inspired did.

References

- [1] <http://www.olimpickgames.com/>
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41 Andrew Marvell (1621–1678)



Work cited	Quotations
The Match. Accessible on: http://famouspoetsandpoems.com/ poets/andrew_marvell/poems/14964	<i>The Naphta's and the Sulphurs heat, And all that burns the Mind.</i>
Blake's Victory Accessible on: http://www.poemhunter.com/ poem/blake-s-victory/	<i>As oaks did then urged by the active fire, Which by quick powder's force, so high was sent, That it returned to its own element.</i>

By the time of Marvell (who postdates Shakespeare) coal was being distributed around England, and naphta probably means tars and oils from its decomposition. Indeed this usage continued until well into the 20th Century when ‘naphtha’ (note the different spelling) started to be used to mean the fraction of crude oil distillation between gasoline and kerosene so its former meaning went into disuse (though not entirely).

‘Blake’ (following row) was Admiral Robert Blake, and the poem quoted from is a laudatory account of his victory over the Spanish Navy at Santa Cruz de Tenerife in 1657. A decisive point in the conflict was the initiation of fire on one of the Spanish ships, which was carrying a major quantity of gunpowder and, in Marvell’s words, ‘so high was sent’.

42 Margaret Cavendish (1623–1673)



Work cited	Quotations
What Atomes Make a Flame? (written in 1653). Accessible on: http://www.poemhunter.com/poem/ what-atomes-make-flame/	<i>Those Atomes, which are Long , sharp at each end, Stream forth like Aire, in Flame, which Light doth seem:</i> <i>For Flame doth flow, as if it fluid were, Which shewes, part of that Figure is like Aire. Thus Flame is joyne'd, two Figures into one: But Fire without Flame, is sharpe alone.</i>
What Is Liquid? Accessible on: http://www.poemhunter.com/ poem/what-is-liquid/#content	<i>All that doth flow we cannot liquid name Or else would fire and water be the same; But that is liquid which is moist and wet Fire that property can never get. Then 'tis not cold that doth the fire put out But 'tis the wet that makes it die, no doubt</i>

The word 'atomes' is used very widely and quite broadly by Cavendish in her poetry [1] and obviously does not have the meaning following from John Dalton's work about a century later. She has identified some important features of flame structure in the poem. A gaseous flame is fluid, and its analysis involves the discipline of fluid mechanics. She mentions 'aire' but not in a sense suggesting rejection of the phlogiston theory, which also came later. She had observed colour variation within the flame ("Thus flame is joyne'd: two figures in one"), now understood as being due to variations in air/fuel ratio along the axis of a flame which relies solely on diffusion for oxygen supply and where fuel is admitted only at the molten tip of the candle. Her observation of these points and anticipation of their interpretation reflects an obvious aptitude. This is perhaps reflected even more strongly in 'What is Liquid' (following row of the table) when the fact that a flame is fluid in nature is again commented upon.

Cavendish was a student of such matters, and published in 1668 'Observations upon Experimental Philosophy' major parts of which are accessible online [2]. It is very broad (though not at the expense of depth) and topics covered include are largely biological e.g. 'Of the eyes of flies' and 'Of the seeds of vegetables'. The chapter of greatest relevance to this text is entitled 'Of the substance of the Sun, and of Fire' and it was of course written before the view that the sun is a combustion process was dismissed⁴². Cavendish writes of her observation of burning phenomena:

[There are] several sorts of flame, [and] have several sorts of fuel to feed on; as for example, the flame of Oyl, the flame of Wood, the flame of Aqua-vitae, the flame of Gums, and the like; all which are very different, not onely in their several tempers and degrees of heat, but also in their several manners of burning or flaming; for the flame of Aqua-vitae is far thinner and blewer, then the flame of Wax, Wood, Tallow, or the like; in so much, that there is as much difference between them, as there is between the Azure Skie, and a white Cloud; which shews, that the flame of spirituous bodies is more airy and rare then the flame of others

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As for 'oyl', fish oil was used in beacons at that time as recorded in the coverage of Cavendish's contemporary John Bunyan. 'Aqua vitae' means of course potent alcoholic liquor and Cavendish's reference to that can be related to what was said about brandy in the discussion of the work of Thomas Middleton (whose life overlapped with that of Cavendish). The 'thin and blue' nature of the flame from aqua vitae is of course common experience. She is not comparing 'wood, wax and tallow' with each other, simply contrasting their flames with the much milder ones of aqua vitae. Wood does however burn differently from wax and tallow and one might reasonably surmise that Cavendish, with her extraordinary powers of observation and deduction, had become aware of this. When a piece of wood burns it first decomposes and the decomposition products – gases, tars and lighter liquids including methyl alcohol – are the fuel which sustains the flame enabling the wood to burn. Heat from this burning feeds back to the solid residue, a.k.a. char, and ignites it so that as long as oxygen supply is not restricted the wood burns completely. This contrasts with wax and tallow where evaporation of molten fuel prior to entry into the flame front is the mechanism of burning. That Cavendish has observed this is not clear from the quotation given but that she had 'intuited' it is highly probable. Her mention of flame temperature is interesting. By Margaret Cavendish's lifetime a basic thermometer had been developed [3]: that was in 1603 and is often wrongly attributed to Galileo. That is not directly relevant to an evaluation of Cavendish's work. Even if she had been able to lay her hands on such a thermometer, for her to have placed it next to the flame would have given no meaningful result. Even in the 21st Century, to measure reliably the temperature of a flame can be challenging and requires corrections to whatever 'raw reading' is yielded by the thermometric device. But the palm of a human hand from a safe distance is sufficient for distinguishing the temperature of a 'oyl' flame from that of an 'aqua vitae' flame. Her terminology, especially 'degree of heat', suggests familiarity with the thinking of the scientists of the day. (Her life overlapped with that of Isaac Newton.)

In concluding the discussion of the remarkable work of Margaret Cavendish note the following from 'Observations upon Experimental Philosophy':

A piece of Green wood that is burning in a Chimney, we may readily discern the Four Elements in its dissolution, out of which it is composed; for the fire discovers it self in the flame, the smoak turns into air, the water hisses and boils at the ends of the wood, and the ashes are nothing but the Element of earth: But if they have no better arguments to prove their principles, they shall not readily gain my consent; for I see no reason why wood should be composed of the Four Elements, because it burns, smoaks, hisses, and turns into ashes

That is remarkably similar to the evaluation of the Four Elements concept discussed in the coverage of the work three centuries earlier of John Gower *q.v.*

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43 John Bunyan (1628–1688)



Work cited	Quotations
<p>Meditations upon a Candle (published posthumously in 1701). Accessible on: http://trutthinheart.com/ EarlyOberlinCD/CD/ Bunyan/text/Book.For.Boys. Girls/Entire.Book.html</p>	<p>Many references to a candle including:</p> <p><i>Man's like a candle in a candlestick, Made up of tallow and a little wick...</i></p> <p><i>The tallow makes the wick yield to the fire...</i></p> <p><i>The blinking candle we do much despise, Saints dim of light are high in no man's eyes...</i></p> <p><i>Good candles don't offend, except sore eyes, Nor hurt, unless it be the silly flies.</i></p> <p style="background-color: #e0e0e0; text-align: center;">Written for children.</p>
<p>The Life and Death of Mr Badman (published 1680). Accessible on: http://www.gutenberg.org/ files/1986/1986-h/1986-h.htm</p>	<p><i>Who, that sees an house on fire, will not give the Allarum to them that dwell therein? Who that sees the Land invaded, will not set the Beacons on a fame?</i></p>

In making such comments and relevant judgements as we can on 'Meditations upon a Candle' we first dismiss any possible idea that it foreshadows the tome of reminiscent title 'Chemical History of a Candle', published by Michael Faraday in 1861. There is however one point of similarity: both were directed at children, in Bunyan's case to impart spiritual principles in a poetic medium and in Faraday's to introduce children in an entertaining yet informative way to science. It is true that 160 years elapsed between Bunyan's 'Meditations' and Faraday's 'Chemical History', but it is equally true that Faraday's book spawned others long after Faraday's own day, a point commented on in the foreword to a standard text on combustion science published as relatively recently as the 1990s. No such claim can be made for Bunyan's discourse on a candle!

The matter of tallow candles and wicks for them was discussed in the section of this book which deals with Shakespeare's 'Merchant of Venice' and it was stated that the wick was probably made of twisted paper. By the 1680s there was major import of cotton into England from the British East India Company [1]. That by the time Bunyan wrote his poem cotton was being used in candle wicks is a plausible suggestion.

Beacons to warn of a battle, which feature in 'The Life and Death of Mr Badman', was a practice followed in Bunyan's lifetime [2]. At least as late as 1685 there was such use of beacons, but they had become obsolete by the Napoleonic wars. In Bunyan's day fish oil would in some locations have been available as a fuel for beacons.

The work for which Bunyan is most noted – 'Pilgrim's Progress' – is so laden with references to fire in poetic and figurative ways that an exegesis along those lines is probably better not attempted.

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44 Aphra Behn (1640–1689)



Work cited	Quotations
<p>The Royal Slave.</p> <p>Accessible on: http://www.gutenberg.org/files/29854/29854-h/29854-h.htm</p>	<p><i>For seeing a Kinsman of mine set some Paper on Fire with a Burning-Glass...</i></p> <p><i>...so that we make our Candles of such an aromatic Substance, as does not only give a sufficient Light, but as they burn, they cast their Perfumes all about.</i></p> <p><i>He [a man condemned to death] had learn'd to take Tobacco; and when he was assur'd he should die, he desir'd they would give him a Pipe in his Mouth, ready lighted; which they did:</i></p>
<p>The Nun, or The Perjur'd Beauty.</p> <p>Accessible on: http://www.gutenberg.org/files/29854/29854-h/29854-h.htm</p>	<p><i>By that bright Sun, the Light and Heat of all the World, you are my only Light and Heat.</i></p>
<p>The Court of the King of Bantam (published c. 1683).</p> <p>Accessible on: http://www.gutenberg.org/files/29854/29854-h/29854-h.htm</p>	<p><i>Oranges roasting by a large Fire, for it was Christmas-time.</i></p>

The quotation from 'The Royal Slave' clearly indicates burning by the focusing of solar radiation, mentioned in other parts of this book including the discussion of 'Clarissa' by Samuel Richardson⁴³. That scented candles were in use by Behn's time is clear from the next quotation. One company having manufactured them at that time is still in the business! [1]. They were seen as the antithesis of the tallow candle, which had a strong negative olfactory impact. The pipe which the condemned man was given to smoke would have been made of clay (see the discussion of Henry Fielding's work). With regard to the quote from 'The Nun', it was written long before the idea that the sun was a combustion process was dispelled. The oranges were being roasted not to be eaten as such but as a dressing for poultry, a by no means obsolete practice now.

Reference

[1] <http://www.hudsongracesf.com/store/candles-cire-trudon-scented-candles>



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45 Daniel Defoe (1660–1731)



Work cited	Quotations
<p>Robinson Crusoe (published 1719).</p> <p>Accessible on: http://www.gutenberg.org/files/521/521-h/521-h.htm</p>	<p><i>While this was doing the master, seeing some light colliers, who, not able to ride out the storm were obliged to slip and run away to sea, and would come near us, ordered to fire a gun as a signal of distress.</i></p> <p><i>Then I got me a piece of the goat's flesh and broiled it on the coals, but could eat very little.</i></p> <p><i>I was cutting down some thick branches of trees to make charcoal...</i></p> <div style="background-color: #e0e0e0; padding: 5px;"> <p>Charcoal would have been made from wood growing at the Desert Island.</p> </div>
<p>Moll Flanders (published 1722).</p> <p>Accessible on: http://www.gutenberg.org/files/370/370-h/370-h.htm</p>	<p><i>She gave me the like cue to the gentlewoman of the next house to that which was on fire, and I did my endeavour to go, but by this time the alarm of fire was so great, and so many engines playing, and the street so thronged with people, that I could not get near the house.</i></p> <div style="background-color: #e0e0e0; padding: 5px;"> <p>Preceded by a description of the initiation of the fire at the house.</p> </div>
<p>The Life, Adventures and Piracies of the Famous Captain Singleton (published 1720).</p> <p>Accessible on: http://www.gutenberg.org/files/6422/6422-h/6422-h.htm</p>	<p><i>During our encampment here we had several adventures with the ravenous creatures of that country; and had not our fire been always kept burning, I question much whether all our fence, though we strengthened it afterwards with twelve or fourteen rows of stakes or more, would have kept us secure.</i></p> <p><i>The heat of the flash, or fire, [from an incident on the ship] was so sensibly felt in our faces...</i></p>
<p>The King of Pirates (published 1720).</p> <p>Accessible on: http://www.gutenberg.org/files/37992/37992-h/37992-h.htm</p>	<p><i>The Night before we went on Board, we made them a Signal by Fire...</i></p> <p><i>...the same Day, at Night, they return'd in the Dark, and set eleven Houses on Fire in the Town where we quartered; which, by the Way, had gone near to have cost me my Life, and would certainly have done so, if in the Hurry I had not seiz'd one of the Incendiaries and deliver'd him up to them.</i></p> <p style="text-align: center;">↑</p> <p>Occurred in Persia.</p>

<p>Roxana: The Fortunate Mistress (published 1724).</p> <p>Accessible on: http://www.gutenberg.org/files/30344/30344-h/30344-h.htm</p>	<p><i>While my maid was gone down on some necessary business, and likewise to get me some burnt wine...</i></p> <p><i>Shall I be fire in his flax?</i></p>
<p>A Tour through the Whole Island of Great Britain (published between 1724 and 1727).</p> <p>Accessible on: http://archive.org/stream/tourthroughthew006736mbp/tourthroughthew006736mbp_djvu.txt</p>	<p><i>...the taverns in London are come to make coal fires in their upper rooms, that cheat of a trade declines; and tho' that article would seem to be trifling in it self, 'tis not trifling to observe what an alteration it makes in the value of those woods in Kent, and how many more of them than usual are yearly stubb'd up, and the land made fit for the plow.</i></p> <p><i>The great centres of population were in the South and the Southern Midlands: the North, though the wool industry was already growing fast in the West Riding, the coal trade fully established round the Tyne, and Lancashire rising rapidly in importance, was in comparison sparsely peopled.</i></p> <p>Many more references to coal in the book, from which the level of employment in its production, movement and distribution at the time can be inferred.</p> <p><i>From this side of the country [the south east] all pleasant and gay, we go over Shooter's Hill [Greenwich], where the face of the world seems quite alter'd; for here we have but a chalky soil, and indifferently fruitful, far from rich; much overgrown with wood, especially coppice-wood, which is cut for faggots and bavins, and sent up by water to London. Here they make those faggots which the wood-mongers call ostrey wood, and here in particular those small light bavins which are used in taverns in London.</i></p>
<p>The True-Born Englishman (poem published in 1701).</p> <p>Accessible on: http://www.gutenberg.org/files/30159/30159-h/30159-h.htm</p>	<p><i>Worshipp'd as God, his Paynim altars smoke, Imbruued with blood of those that him invoke</i></p>

<p>A Journal of the Plague Year (published 1722).</p> <p>Accessible on: http://www.gutenberg.org/ files/376/376-h/376-h.htm</p>	<p><i>all [building and structures close to the Thames] which were either burned down or damaged by the great fire of London, the next year after the plague.</i></p> <p><i>I suppose the world has heard of the famous Solomon Eagle, an enthusiast. He, though not infected at all but in his head, went about denouncing of judgement upon the city in a frightful manner, sometimes quite naked, and with a pan of burning charcoal on his head.</i></p> <p><i>The inconveniences in Spain and Portugal were still greater, for they would by no means suffer our ships, especially those from London, to come into any of their ports, much less to unlade. There was a report that one of our ships having by stealth delivered her cargo, among which was some bales of English cloth, cotton, kerseys, and such-like goods, the Spaniards caused all the goods to be burned, and punished the men with death who were concerned in carrying them on shore.</i></p> <p><i>Also, he tied the horse to a gate in the hedge just by, and got some dry sticks together and kindled a fire on the other side of the tent, so that the people of the town could see the fire and the smoke, but could not see what they were doing at it.</i></p> <p><i>... and made a great many smokes of pitch, of gunpowder, and of sulphur, all separately shifted, and washed their clothes, and the like. As to the poor man, whether he lived or died I don't remember.</i></p>
<p>The book recounts the plague of 1665, when Daniel Defoe was 5 years old.</p>	
<p>A Journal of the Plague Year (cont.)</p>	<p><i>Some [residents of London] were for [in favour of] [domestic] fires, but that they must be made of wood and not coal, and of particular sorts of wood too, such as fir in particular, or cedar, because of the strong effluvia of turpentine; others were for coal and not wood, because of the sulphur and bitumen; and others were for neither one or other.</i></p> <p><i>Two particular trades were carried on by water-carriage all the while of the infection, and that with little or no interruption, very much to the advantage and comfort of the poor distressed people of the city: and those were the coasting trade for corn and the Newcastle trade for coals.</i></p>
<p>An Essay upon Projects (first published 1697).</p> <p>Accessible on: https://ebooks.adelaide.edu.au/d/defoe/daniel/d31es/complete.html</p>	<p><i>After the Fire of London the contrivance of an engine to quench fires was a project the author was said to get well by, and we have found to be very useful.</i></p> <p><i>The second of these (viz., the great wages paid by the merchant) has cost trade, since the war, above twenty millions sterling. The coal trade gives a specimen of it, who for the first three years of the war gave 9 pounds a voyage to common seamen, who before sailed for 36s.; which, computing the number of ships and men used in the coal trade, and of voyages made, at eight hands to a vessel, does, modestly accounting, make 89,600 pounds difference in one year in wages to seamen in the coal trade only.</i></p>

<p>From London the Land's End (published in 1724).</p> <p>Accessible on: http://www.gutenberg.org/ files/1149/1149-h/1149-h.htm</p>	<p><i>But this happy circumstance, which so distinguished Alresford from all her neighbours, was brought to an end in the year, when by a sudden and surprising fire the whole town, with both the church and the market-house, was reduced to a heap of rubbish; and, except a few poor huts at the remotest ends of the town, not a house left standing.</i></p> <p><i>It [a species of bird encountered in Cornwall] will steal and carry away anything it finds about the house that is not too heavy... sometimes they say it has stolen bits of firebrands, or lighted candles, and lodged them in the stacks of corn and the thatch of barns and houses, and set them on fire; but this I only had by oral tradition.</i></p> <p><i>These two rooms are filled with the family pieces of the house of Herbert, most of them by Lilly or Vandyke; and one in particular outdoes all that I ever met with, either at home or abroad; it is done, as was the mode of painting at that time, after the manner of a family piece of King Charles I., with his queen and children, which before the burning of Whitehall I remember to hang at the east end of the Long Gallery in the palace.</i></p> <p><i>Before we reach Basingstoke, we get rid of that unpleasant country which I so often call a desert, and enter into a pleasant fertile country, enclosed and cultivated like the rest of England; and passing a village or two we enter Basingstoke, in the midst of woods and pastures, rich and fertile</i></p>
<p>The Complete English Tradesman (first published 1726).</p> <p>Accessible on: https://www.gutenberg.org/ files/14444/14444-h/14444-h.htm</p>	<p><i>A brickmaker being hired by a brewer to make some bricks for him at his country-house, wrote to the brewer that he could not go forward unless he had two or three loads of spanish, and that otherwise his bricks would cost him six or seven chaldrons of coals extraordinary, and the bricks would not be so good and hard neither by a great deal, when they were burnt.</i></p> <p><i>Likewise in the distress of the late fire which began in Thames Street, near Bear Quay, a grocer might have had a quantity of goods in a warehouse thereabouts, or his shop might be there, and the goods perhaps might be sugars, or currants, or tobacco, or any other goods in his way, which could not be easily removed;</i></p> <p><i>...the shopkeeper is sometimes a merchant adventurer, whether he will or not, and some of his business runs into sea-adventures, as in the salt trade at Sheffield, in Northumberland, and Durham, and again at Limington; and again in the coal trade, from Whitehaven in Cumberland to Ireland, and the like.</i></p> <p><i>The order is 150 chests Seville; it is supposed he means oranges, but it may be 150 chests orange-trees as well, or chests of oil, or any thing. Lisbon white, may be wine or any thing else, though it is supposed to be wine.</i></p> <p><i>...and in yarn at and in the looms at the weavers'; in rape-oil, gallipoli oil</i></p>

Memoirs of a Cavalier (first published 1720).

Accessible on:
[http://www.gutenberg.org/
files/12259/12259-8.txt](http://www.gutenberg.org/files/12259/12259-8.txt)

By virtue of these passes I got into the Imperial army, under Count Tilly, then at the siege of Magdeburg, May the 2nd.

I confess I did not foresee the fate of this city, neither, I believe, did Count Tilly himself expect to glut his fury with so entire a desolation, much less did the people expect it...

fresh men coming up, and the administrator of Magdeburg himself being wounded and taken, the enemy broke in, took the city by storm, and entered with such terrible fury, that, without respect to age or condition, they put all the garrison and inhabitants, man, woman, and child, to the sword, plundered the city, and when they had done this set it on fire...

Of 25,000, some said 30,000 people, there was not a soul to be seen alive, till the flames drove those that were hid in vaults and secret places to seek death in the streets rather than perish in the fire.

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A ‘collier’ here means of course a vessel bearing coal as cargo, and there were many such off the east coast of England at the time Robinson Crusoe sailed, at the outset of his travels, from Hull with London as the intended initial destination. This was in 1651, the year in which the story begins [1, 2]. The colliers were of course sailing ships: steam was not to follow for well over a century. The second quotation in the table is the first of many mention of ‘coals’ in the story and appertains to the period when Crusoe was shipwrecked and making frequent excursions to the wreck for such requisites and supplies as he could salvage. It is of interest to speculate on the origin of the coal used to cook ‘goat’s flesh’ (there were goats on the island). The present author has been unable to find any support for the conjecture that a ship’s chandler in the 16th Century would provide a small amount of coal as a general-purpose fuel amongst the other supplies. That they sometimes did is a reasonable idea, especially having regard to the fact that Robinson Crusoe’s ship departed from London which was the distribution centre for English coal of the period, as noted. A second conjecture is that, quite simply, pieces of coal had been washed up on to the beach at Robinson Crusoe’s location. That it was a beach location is clear from the narrative. For subsea coal to find its way to the surface through tidal stresses is by no means rare and is a well documented phenomenon at places including south east Scotland. Almost without doubt that would have been known to Defoe, in whose day (as noted) Tyneside, close to the border with S.E. Scotland, was a major coal producing region of England. Coal at beaches has been observed by voyagers other than the fictitious Robinson Crusoe, for example by the occupants of Charles Darwin’s ‘Beagle’ who reported coal on the beaches in Chile. It is recorded [3] that the coal there could be accessed in a trouble-free way by digging about two feet below the surface. There might have been a similar resource at the scene of Robinson Crusoe’s shipwreck.

Robinson Crusoe also availed himself of charcoal as a cooking fuel. It would appear that this was not because of depletion of coal but because at a particular time he wanted to avoid drawing attention to himself: to light a smoky coal fire was a sure way of doing just that, whereas charcoal burns with less if any smoke.

Tentative further inferences can be made here. If the coal available to Robinson Crusoe had a propensity to smoke it was probably a high-volatile coal. That discovered by the occupants of the ‘Beagle’ is described as being ‘like charcoal’. Probably simple tests on it had been done with the result that burning with little smoke had been observed. If so the coal was classifiable as low-volatile. This reasoning can be taken even further. If Robinson Crusoe was so concerned about the smoke from burning the local coal, the coal might have been lignite a.k.a. brown coal, the lowest rank of coal of all and very smoky. Exactly where the island of Robinson Crusoe’s shipwreck was has been discussed by exegetes and that it was in the Caribbean has been seen as a plausible hypothesis. It is a simple fact of coal geology [4] that there is lignite in the Caribbean, notably off Barbados, and that this is to the exclusion of lower volatile, less smoky coals. It is not being suggested for a moment that Robinson Crusoe’s location was Barbados: what does make every sense is that wherever it was in the Caribbean it was within access of what coal geologists call a ‘lens’ of lignite in an otherwise inorganic geological structure. Such ‘lenses’ are being discovered internationally all the time as previously uncharted regions are being evaluated for minerals.

From the above paragraph two points can be made. If the coal was lignite it must have been local, not part of the ship's supplies. There is very little lignite in England, and the colliers going from Tyneside to London would have been carrying black coal only. The second point, much more difficult to address, is this. Was it possible that Defoe had any idea at all of the scientific principles in the previous paragraph? Such lignite as there is in England is in Devon's Bovey Basin [4] and it occurs with clay which was being dug out by the 16th Century [5]⁴⁴. To this can be added to that that Defoe did make a geographic study of Devon(shire) [6]. It is not possible that Defoe reasoned as closely as the present author, with the benefit of all the relevant researches since the early 18th Century, has in the paragraph above. An insightful mind like Defoe's can however start to conceive discoveries of the future, not necessarily as such but as their manifestations in the present. It has been reasoned that in one of his Sherlock Holmes stories Arthur Conan Doyle wrote as if he had some intuition that there was natural gas in the North Sea, not only decades before this gas was discovered but, more importantly, without seriously thinking about it or seeing it as being more than incidental to what he was writing about [7]. All that is being said in relation to Defoe and this part of 'Robinson Crusoe' is that there is a possible similarity to that.

Moving on the 'Moll Flanders' the mention of a fire engine is at first consideration surprising for a discourse from 1722⁴⁵. There were however by that time pumps, manually operated, for directing water at fires, and a state-of-the-art fire pump at the time of 'Moll Flanders' could supply 400 litres of water per minute to a fire 40 metres away. There is a strikingly close correspondence to present-day fire fighting practices at sea, especially where there is oil production and movement, at the present time. A fire fighting vessel is classified on its 'delivery', meaning rate of water supply, and its throw, meaning how far water exiting from it is projected before starting to descend under gravity. By the time of 'Moll Flanders' every London Parish had to be in possession of pump and there were men whose duty it was to bring it into service when it was needed [8]. This of course was the forerunner to the fire brigades of later generations. The term fire engine was a recently introduced one at the time it was used in 'Moll Flanders'.

The first of the quotations from 'The Life, Adventures and Piracies of the Famous Captain Singleton' relates to the practice of the use of fire to keep away predatory animals. It used wood as fuel and was set up so as to be smoky, the respiratory irritation caused being as strong a deterrent to prowling beasts as visible flames would have been. This can be achieved by packing wood densely so as to promote smouldering rather than flaming behaviour.

In the discussion herein of the work of Edmund Spenser, who predates Defoe by a century, the origin of the term 'sensible heat', which acquired a precise meaning when thermodynamic principles were first formulated, was discussed. In the second quotation from Defoe in the table there is a further example of use of the word 'sensible' in its thermal sense.

Moving on to 'The King of Pirates', whatever lights were used as a signal in shipping predate by nearly a century those described by Francis Scott Key *q.v.* There were however such devices at the time of 'The King of Pirates' and they had an incendiary as well as a signalling role. It is noted in the table that the fire attempts in the second quotation occurred in Persia. What flammable substances were used in the incendiaries? The period predates by a century and a half the oil industry, but it long *postdates* distillation of crude oil on a local basis to make thermal weapons: it is recorded in [9] that oil was used as a 'weapon of war' early in the Christian era. There was distillation of oil in Persia long before the book under consideration was written, and that the products were used in intentional lighting of fires as in the quotation in the table is a plausible suggestion. Moving on to the first quotation from 'Roxana: The Fortunate Mistress', at the time of the book 'burnt wine' was a common term meaning wine from which some of the alcohol had been removed by heating [10]. Without going into discussion of phase equilibria, azeotropes and the like it is clear that alcohol will be lost more than proportionately when a mixture of it and water (an approximation to the composition of the liquor) is heated. With regard to the next quotation, 'flax' occurred surprisingly frequently in the study leading to the writing of the present book. It was reported in the section on Chaucer that flax products were imported into England from France in his time, and in Defoe's time it was imported from North America. 'Fire in his flax' as a figure of speech might mean use of flax in a slow match, as described in one of the endnotes. That slow matches were still in use at the time of the story is known [11]. 'Fire in his flax' might be a reference to spontaneous combustion of flax in the presence of oil from its seeds. This reality would have been known to producers and exporters and might have become the basis of an ephemeral figure of speech that way.



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Defoe's 'Tour through the Whole Island of Great Britain' is abundant in references to the use of fuels, especially coal vis-à-vis wood at the time. The first quotation in the table expresses this, in relation to Kent in particular, very clearly. (One infers from this quotation that trees excess to purchase demand for firewood had been uprooted to make the land available for more lucrative use.) Tyneside had been the focus of coal production for centuries, and that it was commencing in Lancashire by the time of Defoe's book is clear. It has to be remembered that this was before the railways (although the canals were starting to come into being), so why Lancashire for initial expansion of coal production? The answer is both simple and widely known: proximity to the port of Liverpool for export to the then American colonies which, at that time and as late as Independence in 1776, were a long way from being self-sufficient in coal. Moving on to the next quotation, it refers to the still considerable trade in wood for fuel use at that time. The quote from 'The True-Born Englishman' is a statement that in Islamic ceremonies no less than in Christian incense is burnt.

The proximity in time of the plague to the Great fire is noted in the first quotation from 'A Journal of the Plague Year'. Solomon Eagle (a.k.a. Solomon Eccles) was a personage of the time and a composer of music [12]. The third quotation reveals use of fire in prevention of spread of the plague to the continent. The use of smoke for urban signalling purposes features in the following quotation. 'Pitch' occurs in the next quotation as it does in the work of other authors including Lady Mary Wortley Montagu *q.v.*, William Blake *q.v.* and (from much earlier) Thomas Malory *q.v.* In the next quotation from 'A Journal of the Plague Year' Defoe predates by nearly a century William Blake *q.v.* in his use of the word 'bitumen'. The next quotation records the fact that movement of coal from Tyneside by boat down the east side of England to London continued during the plague. The mention of corn is interesting. It was referred to in the discussion of Munday, about a century before Defoe, that in his time corn was like crude oil in the present age in that it was like currency. That that was still true in Defoe's time is suggested by the need to keep the corn trade going during the critical circumstances of the plague. There is an interesting general point to this. It is an adage that people need only food to live, modified in recent generations to the view that people need both food and energy from fuels in order to live. That that is so in the 21st Century is very difficult indeed to gainsay. The fact that coal and corn were both kept in circulation at the grave period of the plague, when the population of England was of the order of 5 millions, is evidence that there was an awareness of the need of thermal energy as well as food for the survival of communities of people at that time. It can be inferred from the quotation that these were made available to the exclusion of other commodities, possibly wool.

The quotation from 'An Essay upon Projects' merits close attention. Development of the steam engine is usually attributed to Thomas Newcomen in 1712, which was during Defoe's lifetime though a very long time after the Great Fire. 'Who invented what' is often a far from clear-cut question, and that a steam engine was in use in removal of water from coal mines by 1689 (still a considerable time after the Great Fire) is accepted⁴⁶. This is attributed to Thomas Savery and was a life-saving device indeed at a time when deep mining for coal was expanding to meet the needs of industrialisation. The engine referred to by Defoe if, as seems probable, it was of the water wheel type mentioned in the discussion of the work of Thomas Campion was no less an 'engine' for the fact that it worked isothermally. The 'war' referred to in the second quotation from this work by Defoe was the Nine Years' War which took place from 1688–1697, so was very recently ended at the time the 'Essay' was published. Coal was taken by vessel from Tyneside to London (a point made several times in the present book) and the countries fighting England were a co-alliance of European countries of which France was the most important. Vessels bearing coal along England's east coast were therefore very vulnerable for as long as hostilities lasted and the higher pay required by crews because of this endangerment is emphatically commented upon by Defoe in the quotation given. There were some losses of coal-bearing ships to enemy action, and as recorded later in the essay a financial levy was imposed upon each vessel owner, proceeds from which would be used to recompense any owner who lost a ship as a result of the hostilities. One assumes that naval vessels were too heavily committed to direct combat to be deployed in coal conveyance, a function to which they were not in any case structurally suitable.

Moving on to 'From London the Land's End' Defoe writing in 1724, is lamenting jeopardy to the character of the Hampshire town of Alresford by a fire which had occurred there in 1689. There had obviously been rebuilding. Defoe would have recalled the fire – he was well into adult life when it happened – and (who knows?) a nostalgia for its past might have excluded a proper appreciation of its qualities since the rebuild. One thing in any case is certain: the rebuilding was of quality houses retaining the cellars of the burnt down ones [13]. The species of bird alleged to have set fire to thatched buildings by means of purloined candles is called the Cornish chough, taxonomic name *pyrrhocorax*. Defoe is not the first author to have made reference to this. William Camden (1551–1623)⁴⁷, made the first major systematic study of the topography the British Isles [14] and in an account of Cornwall has this to say of the species of bird under discussion [15]:

*This bird the inhabitants have been found to be an incendiarie and thievish besides:
for oftentimes it conveieth sticks setting their houses afire...*

The ‘burning of Whitehall’ referred to in the next italicised quotation occurred in 1691 when Defoe was about 30 years old. It was accidental, having been caused by a candle being held by a maid [16]. Clearly Defoe had been inside the building before the fire and, displaying a retentive visual memory, noted that the pictures he referred to had been rescued from it and relocated. The beauties of the area around Basingstoke which Defoe describes with such enthusiasm and inspiration were not to last. It was about a generation later that the woodlands of southern England were to be stripped to make charcoal for iron production.

The narrative from ‘The Complete English Tradesman’ goes on to explain, with an element of humour, that ‘spanish’ (note the lower case ‘s’) meant different things to the brick manufacturer and to his customer the brewer. To the latter it meant molasses, used as a sweetener in the production of ale. To the former it meant coal ash as an ingredient for the bricks⁴⁸. The fire at ‘Thames Street, near Bear Quay’ referred to in the next quotation occurred in January 1715 [17] and was ‘big news’ in that it spread to and destroyed a major public building. Defoe here was speaking of an event about a decade before the writing of his book. By the time Defoe wrote the book coal export from Whitehaven to Ireland (following quotation) had been taking place for approaching a century, actually since 1634 [18]⁴⁹. Development and expansion in Ireland were strong and there has been heavy dependence on the import of coal, not only from Whitehaven but (a point which Defoe misses) also from the west of England and from Wales [19]. To that can be added a point already made in the present book: that large amounts of coal departed England for the USA via Liverpool at that time. The ‘oil’ referred to in the next quotation is clearly palm oil, which people still source from Lisbon. Interestingly, palm oil was at the time Defoe was writing used in lubrication as well as being an ingredient of the more expensive candles [20]. Lubricating oil from crude oil was not to follow for over a century. ‘Rape-oil’ and ‘Gallipoli oil’ (next quotation) were also lubricants at that time. The former is now of course a basis of some biodiesels.

The quotation from Defoe’s ‘Memoirs of a Cavalier’ relates of course to the ‘Sack of Magdeburg’ in 1631 and the important part that ‘combustion’ played in it. We are informed in [21] that reverberations across Europe were major. Magdeburg is about 140 miles from Dresden where the civilian bombing in WW II caused about 25000 fatalities. Of more significance than the approximate correspondence of numbers of fatalities is the fact that the bombing of Dresden too had repercussions, and those living over the period when there were still many WWII veterans of working age in the population (and in government and the media) heard continual commentaries on it. Is it a ‘long shot’ to link Magdeburg (1631) and Dresden (1945) as analogous events? Probably not, but there is one limitation: it was (is) common to compare Dresden with Hiroshima, but obviously there was no analogue of the Hiroshima bomb in the 17th Century but nor was there a Pacific theatre to the war being fought.

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46 Jonathan Swift (1667–1745)



Work cited	Quotations
'A Description of the Morning' (poem written 1709).	<p><i>The small-coal man was heard with cadence deep; Till drowned with shriller note of 'chimney sweep'</i></p> <p>The poem relates to London where Swift, who was from Ireland, was living at the time he wrote it.</p>
'Gulliver's Travels' (first published 1726). Chapter 2.	<p><i>I delivered up both my pistols in the same manner as I had done my scimitar, and then my pouch of powder and bullets; begging him that the former might be kept from fire, for it would kindle with the smallest spark, and blow up his imperial palace into the air.</i></p> <p>Gunpowder also features later in 'Gulliver's Travels'.</p>
'On Burning a Dull Poem' (short poem published in 1729).	<p><i>In haste, with imprecations dire, I threw the volume in the fire; When, (who could think?) though cold as ice, It burnt to ashes in a trice. How could I more enhance its fame? Though born in snow, it died in flame.</i></p>
'A Satirical Elegy On The Death Of A Late Famous General' (written in 1722). Accessible on: http://www.poemhunter.com/poem/a-satirical-elegy-on-the-death-of-a-late-famous/	<p><i>This world he cumber'd long enough; He burnt his candle to the snuff;</i></p>
'On An Ill-Managed House' Accessible on: http://www.poemhunter.com/poem/on-an-ill-managed-house/	<p><i>Chimneys, with scorn rejecting smoke</i></p>
'A Journal to Stella' (published posthumously in 1766). Edited form accessible on: http://www.gutenberg.org/files/4208/4208-h/4208-h.htm	<p><i>I have gotten half a bushel of coals. Your mother sent me last night a parcel of wax candles. My wax candle's almost out, but however I'll begin. Stella, let me go slumber; and put out my wax-candle. His [the Earl of Abingdon's] carps were raw, and his candles tallow.</i></p>

It is noted in [1] that the ‘shriller’ announcement of the chimney sweep’s availability originated from pre-puberty males engaged in the trade. This shameful practice continued, of course, long after Swift’s day. In the quotation from Chapter II of Gulliver’s Travels, Gulliver had been ordered to divest by the Emperor of Lilliput himself of the belongings on his person and cautioned his captors on the dangers of the gunpowder in his pouch. He informs readers that the pouch was waterproof. Swift in an emphatic and humorous way expresses a low opinion of the poem the written version of which was incinerated in ‘On Burning a Dull Poem’. His intention of entertaining a reader in an account of what might expressed differently have been seen as a reckless act is clear. One wonders a little how closely he had observed the reduction ‘in a thrice’ to ashes. Sometimes when paper is destroyed by fire major parts of it remain very thin and fragile in a carbonised, not completely combusted, form, and any writing on these remains legible⁵⁰. The contents of the burned document are therefore salvageable. That would have been to Swift’s chagrin! Even so, the phenomenology described is well documented. If Swift (speaking in his poem in the first person singular) had wanted to avoid this he could have pulverised the burned residue with a poker, but certainly does not record having done this. That would have been to ‘enhance its flame’! The quotation from ‘A Satirical Elegy On The Death Of A Late Famous General’ is relevant to the practice emphasised that over the long period covered by this book candles were snuffed out, not blown out. To a reader wanting to know the scientific basis of the difference it is this: to snuff a candle is to deprive it of the oxygen it needs to sustain burning, whereas to blow out a candle is to destabilise the flame to a degree where it extinguishes. The reference to chimneys and smoke in the next quotation from Swift refers not to a badly managed house but to a badly designed one: it is shown in analysis of ‘Upon the Duke of Marlborough’s House at Woodstock’ by Alexander Pope that at that time ‘rejection’ of smoke by chimneys could be controlled only by configuration of masonry. Simple devices enabling smoke to be controlled without re-ordering the chimney did not become available until the 19th Century, as recorded in the discussion herein of Jane Austen’s ‘Persuasion’ from considerably later.

‘A Journal to Stella’ is a series of communications in which the term ‘bushel’ of coal features several times. In 18th century England [2] a bushel denoted 2217.6 cubic inches, or 2815.5 cubic inches if ‘heaped’. These convert respectively to 36.3 litres and to 46.1 litres. In fact the ‘unheaped’ value still stands in the 21st Century even though the unit is obsolete. The fact that acknowledgement of the gift of candles specified that they were wax indicates that they were beeswax: the term wax candle would not have been used if they were made of tallow. This point is made unequivocally in [2], which takes in the date in which the ‘A Journal to Stella’ was published. Later Swift precedes ‘candle’ with ‘wax’, a detail indicating that a wax candle was to be distinguished from an inferior tallow one even in informal communication. In drawing attention to the fact that the Earl of Abingdon used tallow candles Swift is making this point again.

To Swift is attributed the quip ‘Burn everything English but their coal’ [3]. Coal was being exported from England to Ireland by this time as reported previously in this book.

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47 Nicholas Rowe (1674–1718)⁵¹



Work cited	Quotations
<p>Jane Shore, A Tragedy (play first performed in 1714).</p> <p>Accessible on: http://www.gutenberg.org/ files/30505/30505-h/30505-h.htm</p>	<p>From Act 2 Scene 1. <i>ALICIA: And watch the wasting of the midnight taper. Such vigils must I keep, so wakes my soul</i></p> <p>From Act 5 Scene 1. <i>BELMOUR: A burning taper in her hand she bore</i></p>

The ‘taper’ features so frequently in literature of this period and has indeed been discussed in this book. A little further discussion follows, before which we note that Jane Shore was a real personage who, though not without personal difficulties and setbacks, moved in privileged circles. A taper, or any other household device featuring in the play, would if in her possession have been what we’d now call up-market. To this can be added the fact that Nicholas Rowe was from a wealthy and influential family. He’d have been familiar with the sight of a taper in a brass taper stick, an image he probably carried through to his writing of ‘Jane Shore’. There is a spin-off point from this: the manufacture of brass at that time, a metallurgical process falling within the scope of this book. Brass was made at that time and earlier by heating copper and calamine (zinc ore, mainly $ZnCO_3$) with charcoal in a crucible [1]. The charcoal liberated elemental zinc from its ore enabling it to form the alloy with copper which we know as brass. England was so heavily wooded at that time that charcoal could be made as and where it was needed. By then coal was replacing wood as a domestic fuel so loss of trees for use as firewood had been brought under control [2]. It would not have been realised that young trees planted then having grown to maturity by the time of the industrial revolution had a role in the control of carbon dioxide emissions.

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48 Alexander Pope (1688–1744)



Work cited	Quotations
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Epistle to Dr Arbuthnot (written 1734). Accessible on: http://www.poetryfoundation.org/poem-alone/174161?iframe=true	<i>Is there who, lock'd from ink and paper, scrawls With desp'rate charcoal round his darken'd walls?</i>
The Rape of the Lock (published 1712). Accessible on: http://www.gutenberg.org/files/9800/9800-h/9800-h.htm	<i>The giddy motion of the whirling Mill, In fumes of burning Chocolate shall glow.</i>
Upon the Duke of Marlborough's House at Woodstock (first published 1714). Accessible on: http://www.bartleby.com/203/49.html	<i>The chimneys are so well design'd, They never smoke in any wind</i>
Ode on Solitude (written in 1700, when Pope was 12 years of age).	<i>Happy the man, whose wish and care A few paternal acres bound... Whose trees in summer yield him shade, In winter fire.</i>

'Small coal'⁵² probably meant slack, coal having by reason of its friability broken into small pieces. Coal in this state is, through possible spontaneous heating, a greater storage hazard than coal in big lumps other things being equal, but that that would be an issue with 'three farthings' worth' is unlikely!

Coal at the time of writing 'Imitations of Horace' would have cost of the order of £1 per ton so 'three farthings' worth' would have been about 3 kilograms: the calculation is a simple one which the interested reader can perform for him/herself. 'Charcoal', made by carbonising wood, has featured several times elsewhere in this book. Its use as a crude writing medium is referred to in Pope's letter to the Scottish John Arbuthnot. (See also the discussion of 'Hudibras' by Thomas Butler.)

Chocolate was introduced into Europe in 1550, and in France and Spain, where there was greater culinary adventurousness than in England, there were numerous recipes for processing it many of which involved heating it [1]. This was so during the 17th Century and would have influenced the young Alexander Pope who, when only in his twenties, slipped related imagery into one of his poems. In the discussion of 'Persuasion' by Jane Austen, published 1816, the point was made that at about that time a device was made available to stop chimneys from 'smoking'. It is clear from the quotation from 'Upon the Duke of Marlborough's House' that this was possible a century earlier. It is not too difficult to put an interpretation on this. The device invented in the early 19th century was for inexpensive retrofitting to a house where there was the problem of chimney smoking. The Duke of Marlborough's purse was such that structural modifications to prevent this inconvenience would have been possible, and these would have performed the same function as the budget device which became available a century later. That the juvenile Alexander Pope, in writing 'Ode to Solitude', referred to a wood fire when he had lived in London where coal was plentiful is at first consideration surprising. In 1700 – the very year in which he wrote the poem – his family moved to a rural environment in Berkshire [2] where wood would have been used as a primary fuel. The coincidence – if it is a coincidence – is remarkable.

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49 Lady Mary Wortley Montagu (1689–1762)



Work cited	Quotations
Letter written from Constantinople [1].	<p><i>I am now sitting this present fourth of January, with the windows open, enjoying the warm shine of the sun, whilst you are sitting over a sad sea-coal fire.</i></p> <p>Written whilst the authoress's husband was British Ambassador to the Ottoman Empire.</p>
<i>Ibid.</i>	<p><i>...before it stand two candlesticks as high as a man, with wax candles as thick as three flambeaux.</i></p>

In the quotation in the first row 'sea-coal' has been used in the same sense as in Shakespeare's 'Merry Wives of Windsor', written over a century earlier. The quotation in the following row has several points of interest. A flambeau is a stronger device than a domestic candle, a torch used for more than background illumination upon which the safety of those relying on its illumination might depend. It might well (consistently with the large diameter – 'thickness' – reported by the authoress) have several wicks. Reference [2] makes the interesting point that a flambeau might use not wax or tallow but pitch as fuel. Lady Mary Wortley Montagu is not exactly describing a flambeau but comparing a domestic candle with one, so the device she was observing would not have been a heavy duty pitch-burning flambeau but a candle using wax. That this was beeswax is the most obvious hypothesis; the Ottoman Empire imported both honey and wax from Europe in the 18th Century [3]. Beeswax was plentiful on European markets at that time.

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50 Samuel Richardson (1689–1761)



Work cited	Quotations
Pamela, or Virtue Rewarded (published in 1740). Accessible on: https://www.gutenberg.org/ files/6124/6124-h/6124-h.htm	<p><i>[Pamela] took refuge in the corner of an outhouse, where wood and coals are laid up for family.</i></p> <p><i>If I can but get work, with a little time for reading, I hope we shall be very happy over our peat fires.</i></p>

An advertisement for SKF featuring a woman with long dark hair smiling in the foreground, with a wind turbine in the background. The text reads: "Brain power", "By 2020, wind could provide one-tenth of our planet's electricity needs. Already today, SKF's innovative know-how is crucial to running a large proportion of the world's wind turbines.", "Up to 25 % of the generating costs relate to maintenance. These can be reduced dramatically thanks to our systems for on-line condition monitoring and automatic lubrication. We help make it more economical to create cleaner, cheaper energy out of thin air.", "By sharing our experience, expertise, and creativity, industries can boost performance beyond expectations.", "Therefore we need the best employees who can meet this challenge!", "The Power of Knowledge Engineering", "Plug into The Power of Knowledge Engineering. Visit us at www.skf.com/knowledge", and the SKF logo.

<p>Clarissa, or the History of a Young Lady (published in 1748. Nine volumes).</p>	<p>From Volume 3, accessible on: http://www.gutenberg.org/files/9881/9881-h/9881-h.htm</p> <p><i>There was, I believe, a kind of phrensy in my manner, which threw her into a panic, like that of Semele perhaps, when the Thunderer, in all his majesty, surrounded with ten thousand celestial burning-glasses, was about to scorch her into a cinder.</i></p> <p>From Volume 4, accessible on: http://www.gutenberg.org/files/10462/10462-h/10462-h.htm</p> <p><i>But as the dear creature has not grudged giving me trouble, I think I ought not, in gratitude, to spare combustibles for her; but, on the contrary, to make her stare and stand aghast, by springing three or four mines at once.</i></p> <p>From Volume 5, accessible on: http://www.gutenberg.org/files/10799/10799-h/10799-h.htm</p> <p><i>I was there in a moment, and found all owing to the carelessness of Mrs. Sinclair's cook-maid, who having sat up to read the simple History of Dorastus and Faunia, when she should have been in bed, had set fire to an old pair of calico window-curtains. She had had the presence of mind, in her fright, to tear down the half-burnt vallens, as well as curtains, and had got them, though blazing, into the chimney, by the time I came up; so that I had the satisfaction to find the danger happily over.</i></p> <p>From Volume 7, accessible on: http://www.gutenberg.org/ebooks/11889</p> <p><i>And yet this very moment it rises to my mind, that 'tis hard trusting too; for surely there must be some embers, where there was fire so lately, that may be stirred up to give a blaze to combustibles strewed lightly upon them...</i></p>
<p>The History of Sir Charles Grandison (published 1753. Seven volumes).</p>	<p>From Volume 4, accessible on: http://www.gutenberg.org/cache/epub/13884/pg13884-images.html</p> <p><i>She took the fire-screen, that hung by the side of the chimney...</i></p> <p><i>Then came my guardian to us, and he kindly took my mother's hand, and conducted her to the fire-side...</i></p>

Bedfordshire where 'Pamela, or Virtue Rewarded' is set is not far, even in the pre-railway days of the setting of the book under discussion, from London, where by then there was major sale of coal as discussed elsewhere in this book. That coal was used at the house where she was engaged did use coal is clear from the passage quoted in the table. Use of peat as a fuel is interesting in the other quotation from 'Pamela, or Virtue Rewarded'. 'Pamela' was employed on a rural estate where peat would have been available if not on it close to it. That peat sometimes served its turn and had an aesthetic appeal in a domestic fire is clear from the quotation and there is the clear implication that it was the fuel of the humbler homes.

In the quotation from Volume 3 of ‘Clarissa’ there is reference to Greek mythology, though probably to a recent presentation of it: in 1744 what we’d now call a ‘musical’ based on Semele, written by George Frederick Handel, was performed in London. Semele’s lifetime was c. 2000 BC. Like Shakespeare and others in a dramatic medium, Handel in a musical medium drew on long-ago events. The basis of the combustion in the quotation from ‘Clarissa’ is of course very simple: focused solar flux formed an ignition source. There were lenses which could have been used for such ‘focusing’ in Greece considerably earlier than 2000 BC, made from minerals such as quartz or silica by polishing [1].

Use of ‘combustibles’ (quotation from Volume 4 of ‘Clarissa’) is clearly figurative and reference [2] is unequivocal on this: such use originated in the 1640s.

The combustion expert is treated to a quite vivid account of an accidental fire in Volume 5 of ‘Clarissa’. Calico is a coarse form of cotton fabric and so burns readily. Interestingly, it was at just about the time that ‘Clarissa’ was written (actually in 1735) that Obadiah Wyld was awarded a British Patent for a flame retardant for fabrics [3]. Probably unwittingly, the narrator of the fire has in the quotation given identified phenomenology now easily interpreted. ‘Half burning’ was followed by blazing: clearly, movement of the ignited articles to get them to the safety of the ‘chimney’ enhanced oxygen supply and accelerated combustion. There is little doubt in the mind of the present author that Obadiah Wyld had he been present would have understood that fully⁵³. ‘Combustibles’ is encountered again in Volume 7.

Moving on to ‘The History of Sir Charles Grandison’, the fire-screen might have been one of two things. It might have been made of metal and designed to protect persons close to the fire from its direct heat. Made of metal, it would in an wealthier household have been ornate on the side visible to occupants of the room. Some survive on the present day antiques market. It was in the day of Samuel Richardson that the ‘cheval screen’ came into use. This was to conceal an out-of-service fireplace in the summer, unsightly in an otherwise tastefully furnished room. These were made of wood. One still sees them in houses where central heating long since replaced ‘fires’ but the fireplace has remained for reasons of authenticity. The ‘fire-screen’ referred to in the quotation was probably in the former category, a heat shield. Was it in place when the act of chivalry recounted in the second quotation was performed?

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51 George Lillo (1691–1739)



Work cited	Quotations
<p>The London Merchant or The History of George Barnwell (written in the year of Lillo's death).</p> <p>Accessible on: http://www.archive.org/stream/londonmerchanto00lillgoog/londonmerchanto00lillgoog_djvu.txt</p>	<p><i>To fan the storm, and wave in fields of fire. And stubborn oaks that yield not to its force, Are burnt, o'erthrown, or shiver'd in its course.</i></p>

In the quotation from 'The London Merchant' Lillo is stating what is now known to those professionally involved with forest fire control. Oak trees are more resistant than most other trees to fire, partly because of their thick bark. A rapidly propagating forest fire will advance towards more easily ignitable trees leaving in its wake oak trees having suffered no worse damage than scorching of the bark [1]. Where there have been fire injuries, oaks show healing from such injuries more readily than some trees. English oaks have been naturalised into parts of Australia for this reason [2]. (Perhaps that is why there are oak trees in England known to exceed a millennium in age.) Of course, that some trees provide better fire protection than others when planted around a residence is well known and not restricted to oak. Such trees in the US are said to be 'fire-wise'. This is in fact quite an industry which Lillo, writing 37 years before US Independence, in a way anticipated.

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52 Eliza Haywood (1693–1756)



Work cited	Quotation
<p>Love in Excess or The Fatal Enquiry (written 1719).</p> <p>Accessible on: http://www.gutenberg.org/ files/10889/10889-8.txt</p>	<p><i>They [domestic servants] are forbidden to play with fire or candles...</i></p>
<p>Life's Progress Through The Passions (written 1748).</p> <p>Accessible on: http://www.gutenberg. org/ebooks/15455</p>	<p><i>...but the wretch, in case his fire-arms should miscarry, had provided a falchion concealed under his coat.</i></p>

In examining the first quotation from 'Love in Excess' one wonders just what is meant by 'playing with fire and candles'. 'Playing with candles' might conceivably mean appropriation of almost used up candles from the living quarters of the householder for use in the servants' quarters where, at the time Haywood was writing, it would be very unusual for the servants to have the luxury of beeswax candles [1]. Instead, such quarters would be more likely to be lit with tallow candles or, more commonly still, 'rush lights'. These were made by soaking plant pith with tallow: the pith acted as a crude wick, and the device was both ineffective (it produced only dim illumination) and malodorous. Conjecture (no more) is that an honest minion of a wealthy household might legitimately remove and replace a spent beeswax candle and try to eke out a few hours from it in the servants' quarters, or gather the remaining wax from several candles too depleted for continued use in the household to put together a makeshift one. Did 'playing with fire' mean removing coals from a fire with tongs? Or did it relate to the outdoor staff, prohibiting them from lighting a fire to keep warm?

In the incident referred to in the second quotation the ‘wretch’ was carrying a sword (‘falchion’) in case the firearm let him down. Why was this precaution taken? Fairly obviously because the holder of the firearm, in a field at the time of the quotation, had just been in a wood. In woods and forests transpiration influences the humidity and can in so doing affect the reliability of gunpowder. That is why the ‘wretch’ had a back-up weapon.

Reference

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53 Françoise de Graffigny (1695–1758)



Work cited	Quotations
Letters from a Peruvian Woman (published 1747). Translation accessible on: http://archive.org/stream/peruvianlettersi00graf/peruvianlettersi00graf_djvu.txt	<i>...saw the Sun only through a thick smoke, and whose sole business it was to forge instruments of death.</i>

Though it is not stated in the translation cited, copper was important in the Peru of that time [1] and was probably the material used to fabricate the ‘instruments of death’. The electrolytic techniques now available for getting copper from its ore were not of course available at the time under discussion in our discourse here we can quote Thomas Carew *q.v.* who, with reference to copper mining in England and Wales stated:

Copper is found in sundrie places, but with what gaine to the searchers, I have not beene curious to enquire, nor they hastie to reveale. For at one Mine (of which I took view) the Owre was shipped to be refined in Wales, either to save cost in the fewell, or to conceal the profit [2].

The ‘fewel’ would have been coal or perhaps charcoal, and the effect of heating it with the copper ore would have been to produce the ‘thick smoke’ which de Graffigny comments on.

References

- [1] Bairett E.M. ‘Copper in New Spain’s Eighteenth Century Economy: Crisis and Revolution’ n.d.
- [2] ‘The Mining of Copper 1760–1820’ Accessible online as a pdf file at the time of going to press, no date or attribution.

54 Stephen Duck (1705–1756)



Work cited	Quotations
On the Hon. Mrs. Horner's Travelling for the Recovery of her Health.	<i>So Metals lie in chymic Fires; And, while the grosser Part expires, The Flames refine the golden Ore, And make it brighter than before.</i>
On Two Young Ladies leaving the Country.	<i>Say, lovely Nymphs! who fly from rural Sweets, To noisy Crowds, thick Air, and smoaky Streets,</i>
Felix and Constance. A Poem, taken from Boccace.	<i>As when, in rural Cots, the Flames aspire, And lab'ring Peasants quench the mounting Fire: If chance a latent Spark remain behind, In heapy Ashes, fann'd with ambient Wind; The Fires again, with former Fury, rise, Flame thro' the Roof, and flash into the Skies</i>

The quotation containing 'chymic fires' obviously has an implication of alchemy at a time which was late for alchemy but before its total disappearance from intellectual life which was not until the 18th Century [1]. Stephen Duck, himself from a rural location and once an agricultural labourer, had lived in London so was drawing on experience in informing the two young ladies about to go and live there of the 'smoaky streets'. In the quotation from 'Felix and Constance' he describes how cottage occupants will form a voluntary team to extinguish a fire, and how easily re-development of fire can occur. The point of re-development was touched on in the discussion of 'The Pastime of Pleasure' by Stephen Hawes *q.v.*, who was over two centuries before Stephen Duck. The phenomenon was obviously a well documented one over a long period.

Reference

[1] <http://www.the-scientist.com/?articles.view/articleNo/40851/title/Illustrating-Alchemy--18th-Century/>

55 Henry Fielding (1707–1754)



Work cited	Quotations
<p>Tom Jones (first published 1749).</p> <p>Accessible on: https://www.gutenberg.org/files/6593/6593-h/6593-h.htm</p>	<p><i>...nor in the imagination of any good people met in a winter evening over a Christmas fire in Somersetshire.</i></p> <p><i>...and not a bushel of coals in her house to supply her with fire.</i></p> <p><i>While the fellow was lighting the upper candles, he cried out to Mrs Miller... Nor could he help observing, with a sigh, when all the candles were lighted, 'That here were candles enough burnt in one night, to keep an honest poor family for a whole twelvemonth.'</i></p>
<p>Joseph Andrews (first published 1742).</p> <p>http://www.gutenberg.org/files/9609/9609-h/9609-h.htm</p>	<p><i>A gentleman sat smoaking a pipe at the door...</i></p> <p><i>...the parson smoaked another pipe, and then they all retired to rest.</i></p> <p><i>...grave man who sat smoaking his pipe by the fire.</i></p>
<p>Journal of a Voyage to Lisbon (first published in 1755).</p> <p>Accessible on: http://www.gutenberg.org/files/1146/1146-h/1146-h.htm</p>	<p><i>...even candles, which had hitherto escaped, were charged with a wantonness of imposition, from the beginning, and placed under the style of oversight. We were raised a whole pound, whereas we had only burned ten, in five nights, and the pound consisted of twenty-four.</i></p> <p><i>Candles! why yes, to be sure; why should not travelers pay for candles?</i></p>

'Christmas fire' denotes a fire using yule logs as fuel. In fact it was particularly prevalent in Devon and in Somerset [1], so the meaning is clear. The second quotation from 'Tom Jones' expresses the penury of the female to whom it relates. This was at a period approaching the declared upper date limit of the present book, as coal was being applied more widely to the manufacture of products. The next quotation relates to the dependence on candles for illumination. Privileged and humble needed such illumination in their respective abodes. The 'upper candles' would have constituted a chandelier, a term which came into use at just the period 'Tom Jones' was being written [2]; it survived and was applied to ornate light fittings when gas lighting became available (although there was the synonymous term 'gasolier') and even later when electric lights became the norm. The point being made by 'the fellow' is that the number of candles it used up in an evening's operation would, if donated to a family who had to live from hand to mouth, have lasted them for a year. A social point is being made by Fielding here with a technical example.

At the time that 'Joseph Andrews' was published 'smoaking' of tobacco was clearly prevalent. A major source of tobacco for English 'smoakers' was Virginia then, before Independence, a colony. Pipes were composed of clay and some of those made in England, notably in Devon, were exported [3]. In the next quotation there are comments on charges made for candles at a guest house in the Isle of Wight on the way to Lisbon. Tallow and beeswax have been mentioned in this book as the basis of candles for illumination, but as is common in weights and measures an independent substance was, at the time under consideration here, used in pricing for illumination from candles. This was spermaceti, obtained from whales, and the illumination from one sixth of a pound of this became the unit of illumination in costing [4]. A spermaceti candle burns with a much brighter light than a tallow one such as would have been used at the guest house. Terms at the guest house were that whatever illumination would have been expected from a pound of spermaceti candles incurred a charge for twenty-four of the tallow candles in service there. Yet only ten tallow candles were in fact used by the voyagers to Lisbon, so in what is described as a 'wantonness of imposition' the residents of the guest house were significantly overcharged. That for the candle illumination to be paid for was, on further thought, acceptable to the 'travellers' is made clear in the following italicised quotation: what was obviously not acceptable was the *overcharging*.

References

- [1] <http://loiselden.com/tag/yule-log/>
- [2] <http://www.etymonline.com/index.php?term=chandelier>
- [3] <http://www.dawnmist.org/gallery.htm>
- [4] <http://www.expressivecandles.com/history.php>

56 Samuel Johnson (1709–1784)



Work cited	Quotations
<p>The Idler (published as a series of essays in the Universal Chronicle between 1758 and 1760).</p> <p>Accessible on: http://www.gutenberg.org/files/12050/12050-8.txt</p>	<p>FROM THE ISSUE FOR SATURDAY MAY 13 1758: <i>...and some are mixing fireworks for the celebration of a peace.</i></p> <p>FROM THE ISSUE FOR SATURDAY JULY 8 1758: <i>We have twice as many fire-skreens as chimneys.</i></p> <p>FROM THE ISSUE FOR SATURDAY AUGUST 26 1758: <i>...had not a ball unfortunately fallen into the powder of one of our ships, which communicated the fire to the rest.</i></p> <p>FROM THE ISSUE FOR SATURDAY MAY 5 1759: <i>...in emulation of Raleigh, to throw it [a book Johnson had written] into the fire.</i></p>
<p>A Voyage to Abyssinia.</p> <p>Originally written in Portuguese in c. 1660 by J. Lobo, and translated into French.</p> <p>Translated from French into English by Samuel Johnson in 1735.</p> <p>English translation accessible on: http://www.gutenberg.org/files/1436/1436-h/1436-h.htm</p>	<p><i>...we tried to compose ourselves again, but had scarce closed our eyes before we were awakened by the fire that had seized our lodging...we found one of the doors barricaded in such a manner that we could not open it. Nothing now could have prevented our perishing in the flames had not those who kindled them omitted to fasten that door near which I was lodged. We were no longer in doubt that the inhabitants of the town had laid a train, and set fire to a neighbouring house, in order to consume us; their measures were so well laid, that the house was in ashes in an instant...</i></p> <p>Johnson was writing of a period prior to his own lifetime in this work.</p>
<p>Life of Mr Richard Savage (first published 1744).</p> <p>Accessible on: http://andromeda.rutgers.edu/~jlynch/Texts/savage.html</p>	<p><i>In this walk they happened unluckily to discover a light in Robinson's coffee-house, near Charing-cross, and therefore went in. Merchant, with some rudeness, demanded a room, and was told that there was a good fire in the next parlour, which the company were about to leave, being then paying their reckoning. Merchant, not satisfied with this answer, rushed into the room, and was followed by his companions.</i></p>

Those three examples from Johnson's 'The Idler' have been chosen because of links with other points made in this book. One is the importance of fireworks on occasions for rejoicing. Another is 'fire skreen': this was discussed under the work of Samuel Richardson, whose life overlapped with Johnson's. The third is the concept of 'communicating' fire: this expression was used by Frances Sheridan (1724–1766). That this was a widely used term at the time, when fire 'spread' was a more obvious term, can legitimately be deduced. The temptation of Johnson to throw a book into the fire and his reference to Raleigh recalls the throwing into a fire of a book written by Walter Burre. Although this story remained in circulation by Johnson's time (Raleigh died in 1618, predeceasing Burre by four years) it is in fact known that this allegation of vandalism of Raleigh's part has no basis in fact [1].

Lobo is writing in an autobiographical style in the quotation in the next column, and that an attempt had, by arson, been made on his life is clear. What is a little less so is his interpretation of the arsonists' modus operandi. The location was the Abyssinian region called Ligonius and, as is stated explicitly in Lobo's narrative, the time of year was Christmas which is well outside the wet season in that part of the world. A trail of dry wood to the house in which the attempt was made on Lobo's life would have been a crude but (as is evident from his own account) effective device, the 'train' from a neighbouring house which he refers to. Debris including leaves and thin twigs might well have formed part of the 'train'. The fact that the target house was 'in ashes in an instant' is further evidence of the dry conditions.

The attractiveness of a 'fire' clear from the quote from 'Life of Mr Richard Savage' was emphasised when the much earlier writings of Thomas Kyd were discussed. The coffee house being in London, one can be confident that the fuel would have been coal.

Reference

[1] Thomson A.T. 'Memoirs of the Life of Sir Walter Raleigh: With Some Account of the Period in which he Lived' Longman, Rees, Orme, Brown, and Green (1830).

57 Laetitia Pilkington (1709–1750)



Work cited	Quotations
<p>Memoirs.</p> <p>Volume 1 accessible on: http://www.exclassics.com/laetitia/lpm1.txt</p> <p>Volume 2 accessible online in pdf form.</p>	<p>From Volume 1.</p> <p><i>...the Dean set about making the coffee, but the fire scorching his hand, he called to me to reach him his glove, and changing the coffee-pot to his left hand, held out his right one...</i></p> <p>From Volume 2.</p> <p><i>This happened to be some public festival, which, as I did not recollect, I sat with the good old gentlewoman till the evening, when on my return home, there was a large bonfire, and a great crowd at the Temple Gate.</i></p> <p><i>It is a very great loss to me, that by the ignorance of my daughter half of my writings were burnt, for she never scrupled, if ever the fire was bad, to take a whole bundle of them to enliven it; but whether this may be any loss to the world I must leave to their judgement.</i></p>

The first quotation recounts a minor domestic mishap. The balance of probability is that the gloves were made of thick leather: happily, asbestos was not yet available. The next quotation is yet another example of a bonfire as a way of marking a special event. The final quotation suggests contempt or vandalism: for the daughter to take her parent's written drafts to 'enliven' a domestic fire was scarcely a responsible thing to do.

58 Sarah Fielding (1710–1768)



Work cited	Quotations
The Governess or The Little Female Academy (published 1749).	<i>...whilst I was asleep [she] set fire to the trees all around me; and waking, I found myself almost suffocated with smoke, and the flames had reached one part of my House. I started from my bed, and striking on the ground three times with my wand, there came such a quantity of water from the heavens, as soon extinguished the fire</i>

‘The Governess’ is a children’s novel, and the exegete has to pare away fantasy from anything having a basis in reality. If what we are being told is that an outburst of rain can help extinguish a fire that is soundly based: there are numerous documentations of such effects including on relating to the very fire-prone Adelaide Hills in South Australia [1]⁵⁴. Making the discussion more general, amongst those involved in rainforest management it is an aphorism that there is greater susceptibility to fire during a drought [2]. Either of these is of course on a vastly larger scale than the localised fire featuring in the quotation.

References

- [1] ‘Rain provides relief for fire-fighters in Adelaide Hills’ <http://www.abc.net.au/pm/content/2015/s4158842.htm>
- [2] <http://www.fao.org/docrep/004/y3582e/y3582e08.htm>

59 Lawrence Sterne (1713–1768)



Work cited	Quotations
<p>The Life and Opinions of Tristram Shandy, Gentleman (written 1759–1767).</p> <p>Accessible on: http://www.gutenberg.org/files/1079/1079-h/1079-h.htm</p> <p>Tristram Shandy (cont.)</p>	<p>From Chapter 3. ↓</p> <p><i>...without setting fire every night to a pewter dish full of brandy, which took off the damp of the air, and made the inside of the tent as warm as a stove.</i></p> <p><i>I infer, an' please your worship, replied Trim, that the radical moisture is nothing in the world but ditch-water – and that the radical heat, of those who can go to the expence of it, is burnt brandy</i></p> <p><i>I believe, an' please your honour, quoth the corporal, that if it had not been for the quantity of brandy we set fire to every night...</i></p> <p><i>...for those who could afford it, as his honour could, without setting fire every night to a pewter dish full of brandy</i></p> <p>From Chapter 1. ↓</p> <p><i>Your organs are not so dull that I should inform you – 'tis an inch, Sir, of red seal-wax.</i></p> <p>From Chapter 2. ↓</p> <p><i>As Francis the first of France was one winterly night warming himself over the embers of a wood fire</i></p>
<p>A Sentimental Journey through France and Italy (first published 1768).</p> <p>Accessible on: http://www.gutenberg.org/files/804/804-h/804-h.htm</p>	<p><i>...a little table with a taper burning was set close beside it, and close by the table was placed a chair: the notary sat him down in it; and pulling out his inkhorn and a sheet or two of paper which he had in his pocket, he placed them before him; and dipping his pen in his ink, and leaning his breast over the table, he disposed everything to make the gentleman's last will and testament</i></p> <p>↑ Written in Paris.</p>

Of the many references to fire and related terms in the novel under review, those to burnt brandy were seen as being the most interesting as in one particular chapter they are so remarkably numerous. They are not however the only features of relevance to the present book. Any 'wax' of those times was animal (bees) or vegetable derived, there being no petroleum wax on domestic or world markets, so the sealing wax referred to in Chapter 1 of 'Tristram Shandy' was probably beeswax. If it was red it would have been dyed with lead oxide. Heat for melting it would also, very probably, have come from beeswax in the form of a candle.

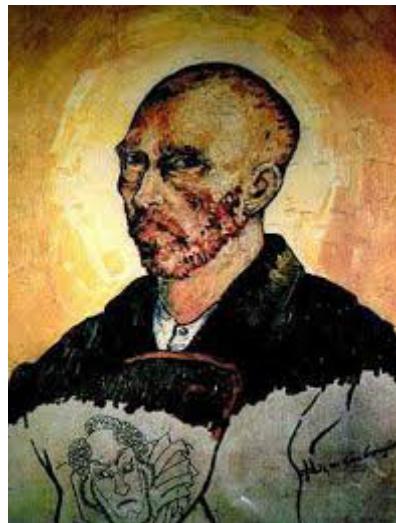
King Francis I of France reigned from 1515–1547. There was coal in France by this time [1], but clearly the wood fire was in service during a military foray, of which there were many during the reign of Francis I (he was captured by the Spaniards during one of them [2]). So Lawrence Sterne here is referring to a wood fire as a way of informing a reader that at the time under discussion the King himself was away from the luxury of his residence and experiencing the more rudimentary comforts of one who has taken active military rank.

The quotation from 'A Sentimental Journey through France and Italy' clearly describes a 'desk set': the means to write a document, including illumination. Such would have been common enough in the France of that period and the wax for the taper would have been beeswax [3] which additionally to providing illumination yielded heat for the melting of sealing wax. There'd have been a snuffer for extinction of the flame (see the discussion of the work of Robert Greene).

References

- [1] Cleveland C.J. 'Concise Encyclopedia of the History of Energy' Academic Press (2009).
- [2] <http://www.habsburger.net/en/chapter/blood-enmity-france-charles-v-against-francis-i?language=en>
- [3] <https://regencyredingote.wordpress.com/2013/01/18/of-wax-jacks-and-bougie-boxes/>

60 Yosa Buson (1716–1784)⁵⁵



Work cited	Quotations
<p>Lighting One Candle</p> <p>Accessible on: http://read.shapeofdesignbook.com/chapter03.html</p>	<p><i>Lighting one candle with another candle</i></p> <p>↑ Translation by R. Hass [1].</p>

Buson in his 'candle' imagery is making the point that to share one's gifts and capabilities does not entail their loss [2]. The physical analogy is sound. A candle would not be reduced in its performance or life expectancy by having been used *carefully* (see comment below) to light another candle. It is known that Buson, who travelled widely within Japan, spent some time in the Kanto region [3] where a leading official had the title 'Danzaemon': between 1603 and 1868, the period taking in Buson's life, there were thirteen successive holders of this office. The tenuous connection with the discussion of the quotation of Yosa Buson's remark on candles is that in the 18th Century the Danzaemon held a monopoly on candle wicks, a point which would not have passed without comment during Buson's residence in Kanto having presumably the effect of making candles more expensive than they would otherwise have been. Whether it inspired his poem – especially as lighting one candle from another is contact of wicks – one might reasonably speculate. Any damage through careless execution of this task – a negation of Buson's message in the poem – would have damaged the wicks and not the wax from which the structure of the candle was made.

References

- [1] <http://www.poemhunter.com/poem/lighting-one-candle/>
- [2] <http://read.shapeofdesignbook.com/chapter03.html>
- [3] http://www.suntory.com/sma/exhibit/2015_2/display.html



61 Sir Horace Walpole (1717–1797)



Work cited	Quotations
<p>The Castle of Otranto (published anonymously in 1764). Accessible on: http://www.gutenberg.org/files/696/696-h/696-h.htm</p>	<p><i>...she seized a lamp that burned at the foot of the staircase, and hurried towards the secret passage.</i></p> <p><i>...but a sudden gust of wind that met her at the door extinguished her lamp, and left her in total darkness.</i></p>

The lamp referred to in the first quotation might have been a conventional candle, or might have comprised a wick floating in tallow. Domestic lamps of that time sometimes had a glass surround, or a metal or ceramic one with a glass pane [1]. The absence of such advanced features is suggested by the second quotation.

Reference

[1] <https://thehistoricfoodie.wordpress.com/2012/12/27/emerging-from-darkness-18th-century-lighting/>

62 Tobias Smollet (1721–1771)



Work cited	Quotations
<p>The Adventures of Peregrine Pickle (published 1751).</p> <p>Accessible on: http://www.gutenberg.org/files/4084/4084-h/4084-h.htm</p>	<p><i>...the instrument [a cudgel] cut sheer even to the bone, on which it struck with such amazing violence, that sparks of real fire were produced by the collision. And let not the incredulous reader pretend to doubt the truth of this phenomenon, until he shall have first perused the ingenious Peter Kolben's Natural History of the Cape of Good Hope, where the inhabitants commonly used to strike fire with the shin-bones of lions which had been killed in that part of Africa.</i></p>
<p>The Expedition of Humphry Clinker (published 1771⁵⁶).</p> <p>Accessible on: http://www.gutenberg.org/files/2160/2160-h/2160-h.htm</p> <p>The Expedition of Humphry Clinker, cont.</p>	<p><i>Shall I commit myself to the high-roads of London or Bristol, to be stifled with dust, or pressed to death in the midst of post-chaises, flying-machines, waggons, and coal-horses.</i></p> <p><i>In our way hither we visited a flourishing iron-work, where, instead of burning wood, they use coal, which they have the art of clearing in such a manner as frees it from the sulphur, that would otherwise render the metal too brittle for working. Excellent coal is found in almost every part of Scotland.</i></p> <p><i>Thus encouraged, I began the execution of my scheme without further delay, and plunged into a sea of expence, though I had no fund in reserve, and the whole produce of the estate did not exceed three hundred pounds a year – In one week, my house was made weather-tight, and thoroughly cleansed from top to bottom; then it was well ventilated by throwing all the doors and windows open, and making blazing fires of wood in every chimney from the kitchen to the garrets.</i></p>

The statement by Peter Kolben has been accessed in its original form [1], and below is an attempt by the present author to paraphrase it:

The hollow which runs through the shin bone of a lion is as small as that which runs through a tobacco pipe; and if the shin is broken to pieces and exposed to the heat of the sun it becomes as hard as flint.

Smollet then is asserting that a cudgel on a human skill can have the effect of two flints in creating sparks and draws on a publication from 20 years earlier in an entirely different setting from that of his novel in so doing. Smollet's day was of course before the rail network, and coal once delivered to ports had to be taken to inland destinations by 'coal horses'. It was in 1771, the year the work under discussion was first published, that a new sort of horse-drawn vehicle for coal conveyance was invented which was to continue in service into the 20th Century. This was known as Moore's patent coal carriage, and had 15 feet diameter wheels and was drawn by a pair of horses [2]. There is remarkable correspondence between the second quotation from 'The Expedition of Humphry Clinker' and Robert Burns' account of his visit to the iron works at Carron near Falkirk in the 1780s, and that coal was plentiful in Scotland at this period was emphasised in the analysis of some of the other work by Burns. In fact Carron Iron works was set up in 1759 (as stated in the section of this book on Robert Burns) and used coal from the beginning, so quite possibly Burns and Smollet are describing one and the same place. In fact it is close to being certain that they are, as Smollet states that he visited the iron works *en route* to Alloa, which is five miles from Falkirk! In the next quotation it sounds as if the writer was operating on a shoestring, so that he had wood fires not coal ones is not surprising. It was probably adventitious wood from 'the estate', not firewood purchased as such. An image of the Carron ironworks, which remained in service until 1982, is shown as Plate 4 below.

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Plate 4. Carron Ironworks. Image taken from:

https://www.google.com.au/search?q=carron+iron+works&biw=1297&bih=691&source=lnms&tbm=isch&sa=X&sqi=2&ved=0ahUKEwjslqmi4MPJAhUGGKYKHXhYAx4Q_AUIBigB#imgdii=hvLUpamikDVqwM%3A%3BhvLUpamikDVqwM%3A%3B7rFt48h277alkM%3A&imgrc=hvLUpamikDVqwM%3A

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- [1] The Prefent State of the Republick of Letters January 1731 Vol. VII William Innys, London (1731).
- [2] Dodsley J. 'The Annual Register, Or, A View of the History, Politics, and Literature for the Year 1771' 5th Edition.

63 Sarah Scott (1720–1795)

Work cited	Quotations
A Description of Millennium ⁵⁷ Hall (published 1762). Accessible on: http://www.gutenberg.org/files/26050/26050-h/26050-h.htm	<p><i>After rubbing her hands and feet till they were sore, suffocating her with burnt feathers, and half poisoning her with medicines, Sir Charles and her servants so far brought her to life...</i></p> <p><i>Those obliged to perform knight's service, might, if they chose to enjoy their own firesides, be excused by sending deputies to supply their places.</i></p>

Use of burnt feathers as a means of revival also occurs, as noted, in the play 'Nobody: A Comedy in Two Acts' by Mary Robinson⁵⁸, which postdates 'A Description of Millennium Hall' by thirty years. The second quotation has been chosen as an example of a point observed so frequently by the present author in preparation of this book: the term 'fireside' is so often used as an expression meaning 'general comfort'.



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64 Christopher Smart (1722–1771)



Work cited	Quotations
Where's the Poker?	<p><i>The poker lost, poor Susan storm'd, And all the rites of rage perform'd... Misfortunes never come alone... But tread each other's heels in throngs, For the next day she lost the tongs... Curse on the author of these wrongs, In her own bed she found the tongs, (Hang Thomas for an idle joker!) In her own bed she found the poker,</i></p>

In spite of early promise Christopher Smart descended into what later became known as hack writing (a term which did not exist in his own day). ‘Where’s the Poker’ is surely an example. That two fireside implements – poker and tongs – went missing and turned up in the same place reflects what was required by writers of that genre.

65 Frances Sheridan (1724–1766)



Work cited	Quotations
Memoirs of Miss Sidney Biddulph (first published 1761). Accessible on: http://www.gutenberg.org/ files/43437/43437-h/43437-h.htm	<i>It happened that the carpenters, who had been employed in fitting up this extempore theatre, had left a heap of shavings in a little place behind the stage, which had been converted into a dressing-room; a little boy belonging to the company had found a candle in it, and having piled up the shavings, set them on fire, and left them burning: the flame communicated itself to some dry boards which lay in the room, and in a few minutes the whole was in a blaze. Some persons, who heard the crackling of the wood, opened the door, when the flame burst out with such violence, that the scenes were presently on fire, and the curtain, which as I told you was dropt, soon caught it.</i>

To use an overworked and therefore somewhat devalued expression, the event recounted in the first quotation is a ‘classic example’ of what is known in the fire protection profession as a smouldering-to-flaming transition. The wood was previously smouldering because of limited oxygen supply, and when the ‘persons’ opened the door the oxygen supply was increased and flaming succeeded smouldering. That the fire ‘communicated itself’ is an interesting expression which later would have been more likely to have been expressed ‘propagated’. There is a reference to this point when the work of James Boswell is discussed.

66 Frances Brooke (1724–1789)



Work cited	Quotations
The History of Lady Julia Mandeville (written 1763).	<p><i>...that heat from which light is inseparable!</i></p> <p><i>We have been dining Al fresco in a rustic temple in a wood near the house: romanesque, simple; the pillars trunks of ancient oaks,</i></p>

The two quotations above have been chosen because of their respective links with points made in other parts of this book. That visible radiation is one component of thermal radiation, and that that was sensed intuitively long before the principles of thermal radiation were formulated, is touched on in the discussion of Campion's 'Now Winter Nights Enlarge'. The longevity of oak trees because of their resistance to fire is mentioned in the discussion of George Lillo's 'London Merchant'.

67 Oliver Goldsmith (1728–1774)



Work cited	Quotations
<p>The Vicar of Wakefield (published 1766).</p> <p>Accessible on: http://www.gutenberg.org/files/2667/2667-h/2667-h.htm</p>	<p><i>Michaelmas eve happening on the next day, we were invited to burn nuts and play tricks at neighbour Flamborough's.</i></p> <p><i>for the flames had, by this time, caught the roof of our dwelling, part after part continuing to fall in, while the family stood, with silent agony, looking on, as if they enjoyed the blaze...</i></p> <p><i>It was therefore out of my power to give my son any assistance, either in attempting to save our goods, or preventing the flames spreading to our corn.</i></p>
<p>She Stoops to Conquer (first performed 1773).</p> <p>Accessible on: http://www.gutenberg.org/files/383/383-h/383-h.htm</p>	<p>From Act 4.</p> <p><i>HARDCASTLE: There's a pair of silver candlesticks, and there's a fire-screen, and here's a pair of brazen-nosed bellows</i></p>

Roasting nuts was a Michaelmas (September 29th) tradition not only in the day of the novel under review, but at least as late as 1910 [1]. The present author's conjecture would be that about then the practice was subsumed into Guy Fawkes night festivities just over a month later in the year. Coincidentally, the date of the book is exactly a century after the Great Fire of London, and by the time of the calamity in 'The Vicar of Wakefield' referred to in the second and third quotations occurred fire insurance was available. It is stated in the following chapter that the dwelling was repaired: whether this was down to insurance or not is unclear. With reference to the term fire-screen, it is discussed in the coverage of Samuel Richardson's 'History of Sir Charles Grandison', written just 20 years before 'She Stoops to Conquer'.

Reference

[1] <http://gggiraffe.blogspot.com.au/2008/04/nut-roast-in-history.html>

68 William Cowper (1731–1800)



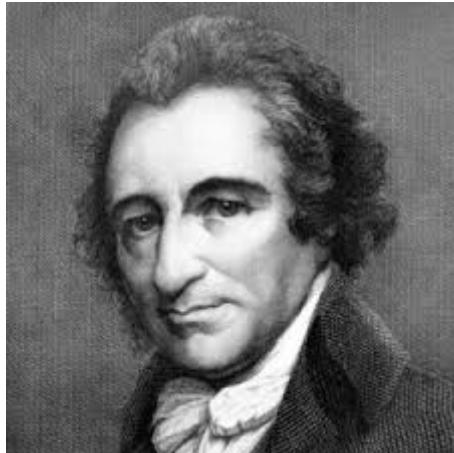
Work cited	Quotations
<p>The Task Book IV The Winter Evening (published 1785).</p> <p>Accessible in part on: http://www.poetryfoundation.org/poem/173293</p>	<p><i>Now stir the fire, and close the shutters fast, Let fall the curtains, wheel the sofa round...</i></p> <p><i>I crown thee King of intimate delights, Fire-side enjoyments, home-born happiness, And all the comforts that the lowly roof Of undisturb'd retirement...</i></p>

Cowper is clearly rejoicing in the comforts of retirement in the first two quotations given. In the discussion of the work of Sarah Scott, a contemporary of Cowper, the point is made that the 'fireside' is so often seen as a representative term for ease and comfort. In fact private means enabled Cowper to 'retire' at 34: the word is put in italics because his own uncertain mental health might have precluded his earning a living beyond then. He was living in London at the time he wrote the piece quoted from. The coal to which he owed the comfort of his fireside probably came from the North East. Even as late as 1785 most of the coal in England came from there although pits in the Pennine region were starting to produce. In contrast to earlier practices, most of the coal from the North East would not be taken all the way to London. Some would, by 1785, have been offloaded at ports along the east side of England including Whitby and Lowestoft, and a collier on arriving in the Thames would contain only a proportion of its initial payload. Canals for internal distribution of coal were in existence by this time [1]. So London was losing its role as the chief distributor of coal within England.

Reference

[1] <https://canalrivertrust.org.uk/canal-history/the-canal-age>

69 Thomas Paine (1737–1809)



Work cited	Quotations
Common Sense (a pamphlet published on 10 th of January 1776).	<p><i>But let our imaginations transport us a few moments to Boston... Endangered by the fire of their friends if they [the residents of Boston] continue within the city and plundered by the soldiery if they leave it, in their present situation they are prisoners without the hope of redemption.</i></p> <p><i>Men of passive tempers look somewhat lightly over the offences of Great Britain, and, still hoping for the best, are apt to call out, Come, come, we shall be friends again for all this... But if you say, you can still pass the violations over, then I ask, hath your house been burnt? Hath your property been destroyed before your face?</i></p>
The Age of Reason (published over the period 1794–1807). Accessible on: https://ebooks.adelaide.edu.au/p/paine/thomas/p147a/complete.html	<p><i>Those who supposed that the sun went round the earth every 24 hours made the same mistake in idea that a cook would do in fact, that should make the fire go round the meat, instead of the meat turning round itself toward the fire.</i></p>
The Crisis Papers [1].	<p><i>The only instance of justice, if it can be called such, which has distinguished you for impartiality, is, that you treated and plundered all alike; what could not be carried away has been destroyed, and mahogany furniture has been deliberately laid on fire for fuel, rather than the men should be fatigued with cutting wood.</i></p> <p><i>The ships in the Thames, may certainly be as easily set on fire, as the temporary bridge was a few years ago;</i></p>

‘Common Sense’ was written during the siege of Boston and clearly refers to it. In the second quotation Paine is challenging those who would favour placating the British and having an amicable relationship with them after cessation of hostilities. He says in effect that someone having had his home destroyed by fire during the siege would not feel that way.

The quotation from 'The Age of Reason' is of course tongue-in-cheek, and a welcome humorous punctuation. That being said, it was still believed at the time that it was written that the sun is a combustion process. In the first quotation from 'The Crisis Papers' in the next row, again with an example relating to burning Paine is making the point that vandalism has no place in a properly conducted military operation. The destruction of the mahogany furniture referred to occurred in Trenton NJ. The 'temporary bridge' across the Thames mentioned in the next quotation was destroyed by fire in 1758 [2].

References

- [1] Paine Thomas 'The Crisis Papers, 1776–1783' Rowman and Littlefield (1990).
- [2] <http://www.gettyimages.com.au/detail/news-photo/three-views-of-old-london-bridge-and-its-temporary-wooden-news-photo/464467713>



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70 Eliza Parsons (1739–1811)

Work cited	Quotations
<p>The Castle of Wolfenbach (written in 1793).</p> <p>Accessible on: http://gutenberg.net.au/ ebooks06/0606211.txt</p>	<p><i>...about midnight he dropped asleep, but was soon awakened by a great smoke and a terrible smell of fire. He hastily got up, and opening the door, the flames burst in upon him...</i></p>

A reader going to the novel for him/herself will learn that the events narrated in the first of the quotations resulted in a fatality. It is noted in commentaries on the book that it is set in France at the time of the Revolution. There is no suggestion in the book however that the fire was the work of the revolutionaries. A fire had been lit to 'air' a room, and the discoverer of the accidental fire was sleeping in a room above. So what conjectures can be made as to the origins of the tragic fire? The castle was 'old' and had been previously deserted for a long time on account of a belief that it was haunted. Both for natural and supernatural reasons only one room was deemed habitable: '...there is a fine old castle just by, where there is room enough, for only one old man and his wife live in it, and, Lord help us, I would not be in their place for all the fine things there'. In other words it was in a state of neglect and disorderliness, and ignition from the sputtering of something from the fire which had been lit would have had a direct propagation route via furnishings and floor coverings.

71 James Boswell (1740–1795)



Work cited	Quotations
<p>Journal of a Tour to the Hebrides with Samuel Johnson (first published 1785).</p> <p>Accessible on: http://www.gutenberg.org/cache/epub/6018/pg6018-images.html</p>	<p><i>In the middle of the room or space which we entered, was a fire of peat, the smoke going out at a hole in the roof.</i></p> <p><i>There is enough of turf, which is their fuel, and it is thought there is a mine of coal.</i></p> <p><i>Dr Johnson talked of the proportions of charcoal and salt-petre in making gunpowder, of granulating it, and of giving it a gloss.</i></p> <p><i>They sell some oil out of the island, and they use it much for light in their houses.</i></p>
<p>An Account of Corsica, (published 1768–1769)</p> <p>Accessible on: http://www.gutenberg.org/files/20263/20263-h/20263-h.htm#Page_101</p>	<p><i>When they want honey, they burn a little juniper wood, the smoak of which makes the bees retire.</i></p>
<p>Life of Samuel Johnson (first published 1791).</p> <p>Accessible on: http://www.gutenberg.org/files/1564/1564-h/1564-h.htm</p>	<p><i>I talked of the difficulty of rising in the morning. Dr. Johnson told me, 'that the learned Mrs. Carter, at that period when she was eager in study, did not awake as early as she wished, and she therefore had a contrivance, that, at a certain hour, her chamber-light should burn a string to which a heavy weight was suspended, which then fell with a strong sudden noise: this roused her from sleep, and then she had no difficulty in getting up.'</i></p>

At the time of the first quotation, Boswell and Johnson were not in the Hebrides but on the northern Scottish mainland close to Loch Ness. That there is so much peat in that part of Scotland that the waters of Loch Ness are charged with it, to the partial loss of their clarity, is well known [1]. The second italicised statement appertains to Isle of Raasay (spelt Rasay by Boswell), and turf of course means peat. The third statement represents 'cocktail party conversation' between Dr. Johnson and a Scottish official by whom he was being entertained. The 'oil' referred to in the next statement is from fish harvested off Scotland⁵⁹. This makes good illuminating oil. It was less than a century after Boswell wrote that that shale oil products started to become available in Scotland. Boswell comments, in his account of a trip to Corsica, on the use of juniper in bee smoking. Juniper trees are very noticeable in the landscape of Corsica [1].

In analysing the quotation from the 'Life of Samuel Johnson', which is obviously a biography, let it be noted that Mrs Carter is not a pseudonym. She lived from 1717 to 1806 and was a member of the Blue Stockings Society [2]. Weight alarms were widely used before alarm clocks were invented, but the one used by the ingenious Mrs. Carter does appear to be of novel design. So how did it work? The string presumably displayed smouldering, not flaming, combustion propagation at a rate of the order of 1 millimetre per minute depending on the width of the string. The precise *modus operandi* of the device is not known, but if Mrs. Carter expected eight hours' sleep the string must have had a length of about:

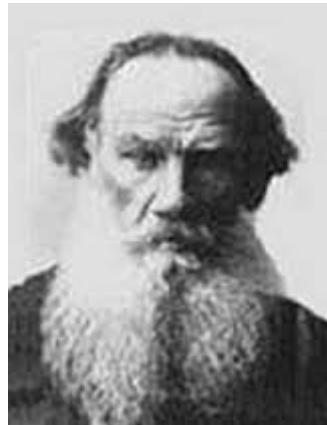
$$10^{-3} \text{ m minute}^{-1} \times (8 \times 60) \text{ minute} = 0.48 \text{ m or 1 foot 7 inches.}$$

All sorts of safety issues arise in the mind of someone considering this. The most obvious is that the string was hopefully situated away from open windows or any other source of air current. That would have caused the smouldering to change to flaming, quite possibly setting fire to the room. Smouldering combustion is accompanied by smoke, which however dilute it was by the time it had diffused to the bed-side would not have done Mrs. Carter's respiratory system any good. However she lived to almost 90, a much less common occurrence then than now.

References

- [1] <http://www.holidaysincorsica.co.uk/Flora.htm>
- [2] <http://www.bbc.co.uk/blogs/radio4/entries/170cff44-2fe9-3733-861f-40931f0e3d7e>

72 Johann David Wyss (1743–1818)



Work cited	Quotations
<p>Swiss Family Robinson (published 1812).</p> <p>Accessible on: http://www.gutenberg.org/files/11703/11703-h/11703-h.htm</p> <p>Swiss Family Robinson (continued).</p>	<p><i>I found a cast-iron mortar, exactly fitted for my purpose, which I filled with gunpowder. I then took a strong oak plank to cover it, to which I fixed iron hooks, so that they could reach the handles of the mortar. I cut a groove in the side of the plank, that I might introduce a long match, which should burn at least two hours before it reached the powder.</i></p> <p><i>The refuse of this fishery, which we threw into the sea, attracted a number of sea-dogs; we killed several for the sake of the skin and the oil, which would be useful to burn in lamps, or even as an ingredient in soap, which I hoped to make at some future time.</i></p> <p><i>I had discovered that the crystals of salt in our grotto had a bed of gypsum for their base, from which I hoped to obtain a great advantage. I was fortunate enough to discover, behind a projecting rock, a natural passage leading to our store-room, strewed with fragments of gypsum. I took some of it to the kitchen, and by repeated burnings calcined it, and reduced it to a fine white powder, which I put into casks, and carefully preserved for use.</i></p> <p><i>...while my wife was occupied in preparing our supper, I amused myself by making some packing-needles for her rude work from the quills of the porcupine. I held a large nail in the fire till it was red-hot, then, holding the head in wet linen, I pierced the quills, and made several needles, of various sizes, to the great contentment of our indefatigable workwoman.</i></p>

The concept of the slow match, discussed in relation to one of the novels of Daniel Defoe, occurs in the above account of the destruction by gunpowder of a wreck. The aim was to open up the vessel to provide access to a pinnace – a ship's boat – in undamaged condition, and it was successful. Very loosely speaking, some of the techniques currently used in demolition of buildings with explosives had been, with some ingenuity, anticipated. Fuel and chemical use of fish oil was also made by these highly resourceful adventurers (second quotation). With regard to the first quotation, a reader should note that production of gypsum as a saleable product from the sulphur content of crude oil is widespread in the 21st Century. That heat was used to make needles from the quills of porcupines is another example of the resourcefulness referred to.

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73 Olaudah Equiano a.k.a. Gustavus Vassa (1745–1797)



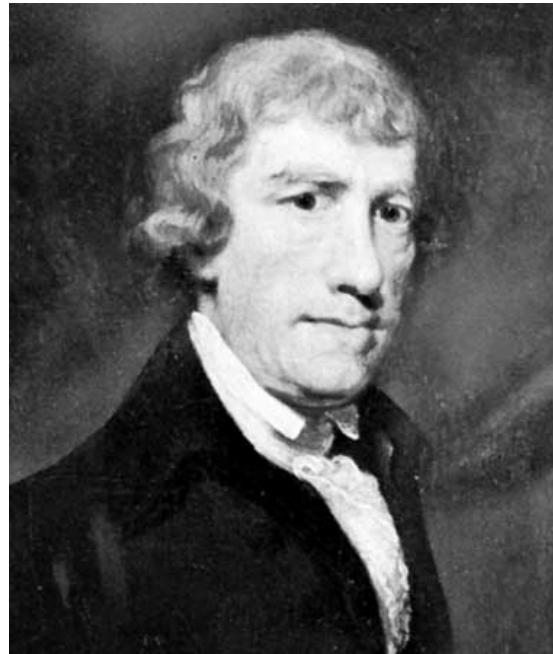
Work cited	Quotations
<p>The Interesting Narrative Of the Life of Olaudah Equiano or Gustavus Vassa the African (published 1789).</p> <p>Accessible on: http://www.gutenberg.org/files/15399/15399-h/15399-h.htm</p> <p>Equiano was a slave who at age 22 bought his freedom. His book relates to pre- and post- freedom experiences.</p>	<p><i>The ceremony being now ended the festival begins, which is celebrated with bonefires [sic], and loud acclamations of joy, accompanied with music and dancing.</i></p> <p><i>Our principal luxury is in perfumes; one sort of these is an odoriferous wood of delicious fragrance: the other a kind of earth; a small portion of which thrown into the fire diffuses a most powerful odour. We beat this wood into powder, and mix it with palm oil; with which both men and women perfume themselves.</i></p> <p><i>One day in our passage we met with an accident which was near burning the ship. A black cook, in melting some fat, overset the pan into the fire under the deck, which immediately began to blaze, and the flame went up very high under the foretop.</i></p> <p><i>In the year 1783 I visited eight counties in Wales, from motives of curiosity. While I was in that part of the country I was led to go down into a coal-pit in Shropshire, but my curiosity nearly cost me my life; for while I was in the pit the coals fell in, and buried one poor man, who was not far from me: upon this I got out as fast as I could, thinking the surface of the earth the safest part of it.</i></p> <p><i>On the 4th of June we sailed towards our destined place, the pole; and on the 15th of the same month we were off Shetland. On this day I had a great and unexpected deliverance from an accident which was near blowing up the ship and destroying the crew, which made me ever after during the voyage uncommonly cautious. The ship was so filled that there was very little room on board for any one, which placed me in a very awkward situation. I had resolved to keep a journal of this singular and interesting voyage; and I had no other place for this purpose but a little cabin, or the doctor's store-room, where I slept. This little place was stuffed with all manner of combustibles, particularly with tow and aquafortis, and many other dangerous things. Unfortunately it happened in the evening as I was writing my journal, that I had occasion to take the candle out of the lanthorn⁶⁰, and a spark having touched a single thread of the tow, all the rest caught the flame, and immediately the whole was in a blaze. I saw nothing but present death before me, and expected to be the first to perish in the flames. In a moment the alarm was spread, and many people who were near ran to assist in putting out the fire.</i></p>

The first quotation relates to a marriage festivity in a polygamous culture. That the fragrant trees in the part of Africa referred to in the second quotation ('Guinea...along the coast above 3400 miles, from the Senegal to Angola, and including a variety of kingdoms') are one of the enjoyments of corporate life there is clear from the second quotation. In a footnote to the edition of the book cited in the table the material described by Equiano as a 'type of earth' is tentatively identified with musk, which can be animal or plant in origin. By the time of the incident in the third quotation Equiano was a free man, and sailing from Barbados to England where his vessel berthed on the Kent coast. Moving on to the next quotation, Equiano's choice of Shropshire as a venue to experience the coal industry is not surprising, as Coalbrookdale in that county was a major centre of the coal trade and advances in mining techniques were being introduced there [1]. Eighteenth Century production of iron in Carron in Scotland was mentioned in the discussion of the work of Tobias Smollet and in that of Robert Burns. That was serviced by the Kinneil coal mine, and miners from Coalbrookdale went there to commission the joint coal mining/iron-producing enterprise, an adventurous undertaking in the days long before railways. That was over 20 years before Equiano's visit to Shropshire. Referring to the next (quite lengthy) quotation, it was commented upon in the discussion of Milton's 'Paradise Lost' that 'combustibles' was used there to mean materials capable of burning, and Equiano about a century later has used the word in the same sense. It was noted in the discussion of Chaucer that he used the word 'tow' to mean fibre such as might be used in soft furnishing, and Equiano so uses this term which has in fact lasted into the 21st Century!

Reference

[1] Ashton T.S., Sykes J. 'The Coal Industry of the Eighteenth Century' Manchester University Press (1964).

74 Henry MacKenzie (1745–1831)



Work cited	Quotations
<p>The Man of Feeling (published in 1771).</p> <p>Accessible on: http://www.gutenberg.org/ files/5083/5083-h/5083-h.htm</p>	<p><i>He looked round at the same time for a poker to stir the fire with, which, he at last observed to the company, the people of the house had removed in order to save their coals.</i></p> <p><i>...for his nurse will tell you, that when he was a child, he broke his rattle, to discover what it was that sounded within it; and burnt the sticks of his go-cart⁶¹, because he liked to see the sparkling of timber in the fire</i></p>

The practice of saving coal can be made by making a poker unavailable is one to which a definitive recommendation cannot be given: only points for and against can be made. To poke a fire is to break up pieces of coal already alight so that the surface area available for burning is increased and this will not make for economy. To do this will stimulate flames which transfer heat partly by radiation, partly by convection and partly as heat in the smoke which goes up the chimney! Only about 30% of the heat from such a flame will be transferred by radiation. If the fire is not poked and flames diminish a quiescent bed will result which is transferring heat by radiation. Not only the part which glows red is so radiating. It is difficult to generalise and to predict which of these – a poked fire or an unpoked one – will provide more heat to a room, in fact impossible to draw conclusions without much more detailed information and a depth of analysis that would not be applied to a simple domestic fire. The matter of pockets of methane in coal has been raised more than once in the present book. These will open up whether the fire is poked or not. If the opening up is induced by poking a tarry residue will probably be evident. The 'sparkling timber' which the inquisitive little boy (who, it seemed, lacked close supervision) would also have been a radiation effect.

Reference

[1] http://www.europeana.eu/portal/record/9200105/BibliographicResource_3000006073760.html

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75 Hugh Henry Brackenridge (1748–1816)⁶²



Work cited	Quotations
<p>The Battle of Bunkers Hill (play written 1776).</p> <p>Accessible on: http://www.gutenberg.org/files/29225/29225-h/29225-h.htm</p>	<p><i>HOWE (British officer): What pity 'tis, such excellency of mind, Should spend itself, in the fantastic cause, Of wild-fire liberty. Warren is dead, And lies unburied, on the smoky hill;</i></p> <p><i>HOWE: Their ammunition, as you hear, is spent.</i></p> <p><i>PIGOT (British officer): The grenadiers stand thinly on the hill, Like the tall fir-trees on the blasted heath, Scorch'd by the autumnal burnings, which have rush'd, With wasting fire fierce through its leafy groves.</i></p> <p><i>BURGOYNE (British officer): A town on fire, and rushing from its base, With ruin hideous, and combustion down.</i></p> <p>The Battle took place in Massachusetts on June 17th 1775. Officers on both sides mentioned in the play are real historical personages.</p>

'Warren', the report of whose lamented death is both preceded and followed by imagery from combustion, was Joseph Warren (1741–1775) [1]. The second of the statements by Howe quoted is recorded in all authoritative accounts of the Battle of Bunkers Hill: that the American side ran out of gunpowder during it. Pigot's reference to the blasted heath is presumably a quotation from Macbeth, where the 'heath' is scene of the witches' cauldron⁶³. His simile apropos of loss of trees by burning would have had a basis in his experience. Fir trees were used in ship building; HMS Victory, commissioned in 1765, contains fir amongst other sorts of timber in its construction, and there was at that time concern about timber shortage for naval construction. Pigot, as a Member of Parliament over the period 1768 to 1772, would probably have been aware of that [2].

The 'town on fire' in the next of the quotations is Charlestown, part of 1775. The houses there were almost entirely timber, making burning of the town very easy [3]. See also the coverage of the work of Philip Freneau.

References

- [1] <http://theamericanrevolution.org/peopleDetail.aspx?people=21>
- [2] <http://www.derekbeck.com/1775/info/robert-pigot/>
- [3] <http://www.loc.gov/exhibits/british/brit-2.html>

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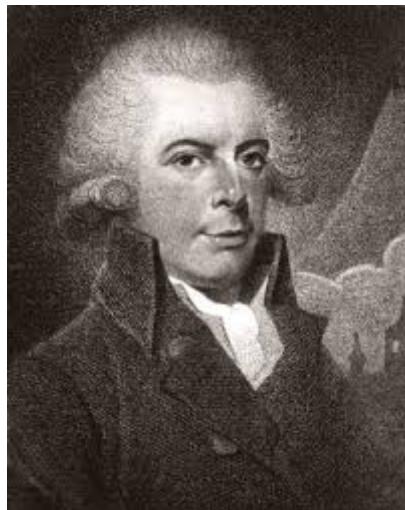
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76 Richard Brinsley Sheridan (1751–1816)

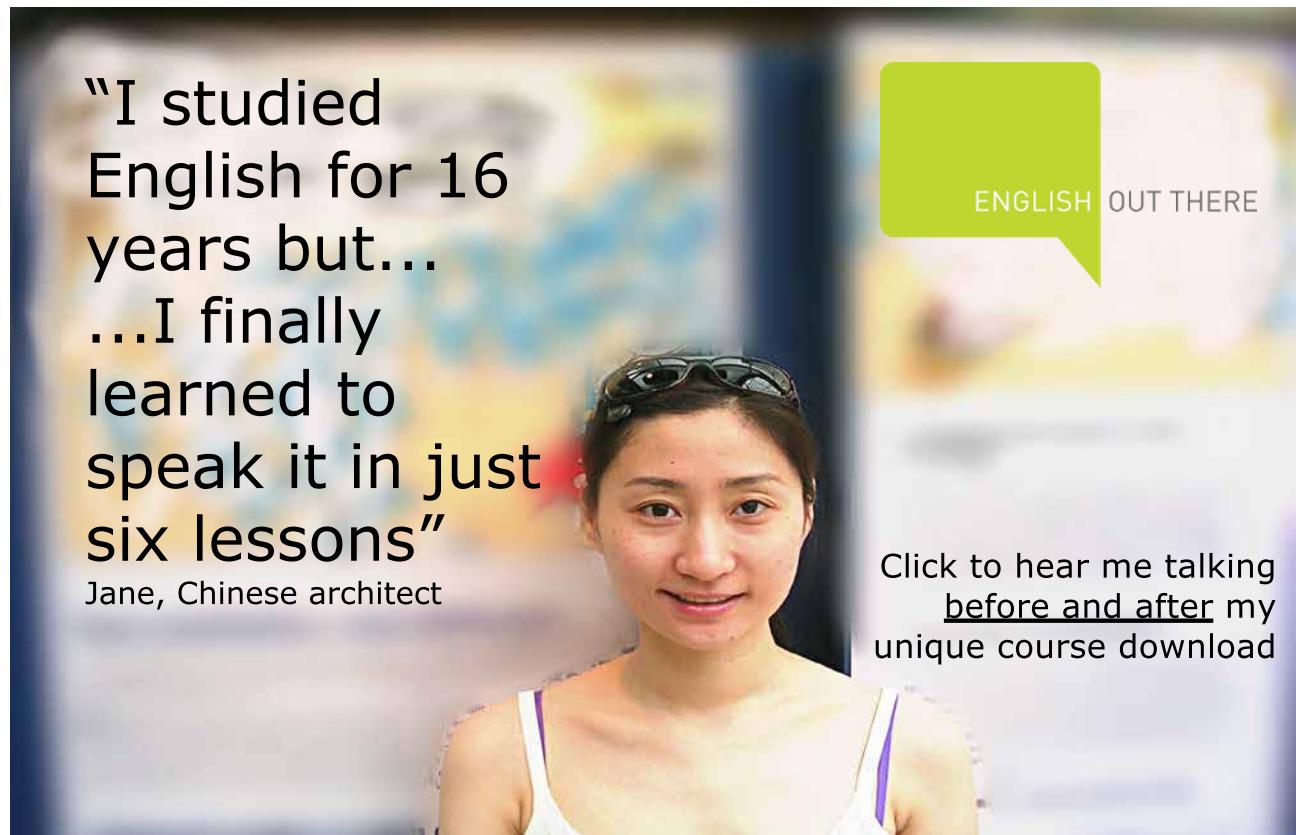


Work cited	Quotations
The Rivals (first performed 1775). Accessible on: http://www.gutenberg.org/files/24761/24761.txt	DAVID: <i>Look'ee, my lady – by the mass! there's mischief going on. Folks don't use to meet for amusement with firearms, firelocks, fire-engines, fire-screens, fire-office</i>
St. Patrick's Day of The Scheming Lieutenant (first performed 1775). Accessible on: http://www.gutenberg.org/cache/epub/6707/pg6707-images.html	O'CONNOR: <i>...but are you sure you do nothing to quit scores with them?</i> FLINT: <i>Nothing at all, your honour, unless now and then we happen to fling a cartridge into the kitchen fire...</i>
A Trip to Scarborough (first performed 1777). Accessible on: http://quod.lib.umich.edu/e/ecco/004873622.0001.000/1:7?rgn=div1;view=fulltext	From Act 3. SIR TUNBELLY [to his servant]: <i>Here, run in a doors quickly; ...coal fire in the great parlour – set all the Turkey work chairs in their places; get the brass candle sticks out.</i>
A School for Scandal (first performed 1777).	CRAB: <i>...lost at hot cockles round a Christmas fire</i>

The terms in the quotation from 'The Rivals' can be examined for meaning. 'Fire screens' occur as noted in Goldsmith's 'She Stoops to Conquer', first performed just two years before 'The Rivals' was. A firelock is of course a type of firearm, in which gunpowder is ignited by a spark instead of by impact initiation. The term fire engine was, as discussed, used in Defoe's 'Moll Flanders' from 1722 and has the same meaning in 'The Rivals' from over 50 years later. A fire office is a fire insurance company [1]. In the quotation Flint, in spite of the fact that he was addressing a superior officer, was being facetious. 'Sir Tunbelly' in 'A Trip to Scarborough' was from the Scarborough area, and the play is set at a time when coal was delivered from Tyneside along the east coast as described in the discussion of 'The Winter Evening' by Cowper *q.v.* To conjecture that the coal fire in the quotation used coal from Tyneside which had been dropped off at Whitby is an altogether plausible suggestion. The household was obviously a well-to-do one, and whatever candles occupied the brass candlesticks sent for would probably have been beeswax. The quotation from 'A School for Scandal' is a reference to the delights of Christmas domestic festivity, so common a theme in literature of the period.

Reference

[1] Sheridan R.B., Colman B. 'The Rivals and Polly Honeycombe' Broadview Press (2012).



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77 Frances Burney (1752–1840)



Work cited	Quotations
Evelina (published anonymously in 1778). Accessible on: http://www.gutenberg.org/cache/epub/6053/pg6053-images.html	<p><i>Yesterday it was settled that we should spend the evening in Marybone Gardens, where M. Torre, a celebrated foreigner, was to exhibit some fire-works.</i></p> <p><i>When notice was given us that the fire-works were preparing we hurried along to secure good places for the sight;</i></p> <p><i>The fire-work was really beautiful; and told, with wonderful ingenuity, the story of Orpheus and Eurydice:</i></p>
Camilla (published in 1796). Accessible on: http://www.gutenberg.org/files/40619/40619-h/40619-h.htm	<p><i>Mr. Dubster then displayed the ingenious intermixture of circles and diamonds projected for the embellishment of his grotto; the first of which were to be formed with cockle-shells, which he meant to colour with blue paint; and the second he proposed shaping with bits of shining black coal.</i></p> <p><i>Mary, now, entering with a coal scuttle and a candle, Lynmere, with much displeasure, called out, 'Bring wood; I hate coals.'</i></p> <p><i>Mary, as much displeased, and nearly as much humoured as himself, answered that nothing but coals were ever burnt in that grate.</i></p>

A good deal about the parts of Evelina in the quotations is recorded in a journal from 60 years later [1]. There were at the time of 'Evelina' firework displays at Marylebone Gardens. In 1775 a Frenchman called Torre was engaged there who incorporated fireworks into drama, actually Orpheus and Eurydice as quoted and as recorded in [1]. It is clear from the accounts that the effect was exquisite in its appeal and beauty. To 'hostile combustion' and 'friendly combustion' could be added 'artistic combustion'.

In the discussion of 'The Nun's Priest's Tale' from much earlier in this book it was pointed out how some coals display more gloss than others, and that the degree of gloss depends on the petrographic content. Clearly the coals in the possession of Mr Dubster in the quotation from 'Camilla' were naturally lustrous. Moving on to the next quotation, why should a particular grate be used for burning 'coals' to the exclusion of wood? The most likely explanation is that wood will cause a greater build-up of flammable residue in a chimney than coal will. The chimney from the wood fire will need not only more frequent but more thorough cleaning using scrapers as well as brushes. Probably a household rule had been made that the particular 'grate' in the story was for coal only for that reason.

Reference

[1] The Mirror of Literature, Amusement and Instruction XXXII Limbird, London (1838).

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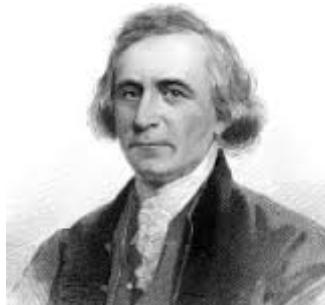
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78 Philip Freneau (1752–1832)



Work cited	Quotations
General Gage's Soliloquy (written in 1775). Accessible on: http://www.gutenberg.org/files/38475/38475-h/38475-h.htm	<i>Charlestown is burnt, and Warren is deceased.</i>
Voyage to Boston (written in 1775). Accessible on: http://www.gutenberg.org/files/38475/38475-h/38475-h.htm	<i>And war's red lamp in Boston cease to burn.</i>
The Adventures of Simon Swaugum, A Village Merchant (written in 1768). Accessible on: http://www.gutenberg.org/files/38475/38475-h/38475-h.htm	<i>Flash'd from that farthing-candle, call'd his soul.</i> <i>Yet here, adjacent to an aged oak, Full fifty years old dad his hams did smoke...Here father smoked his hogs.</i>

Freneau was born in New York City and died in New Jersey. He was in young manhood at Independence. The first quotation from his work given refers to exactly the same even as that described in 'The Battle of Bunkers Hill' by Hugh Henry Brackenridge *q.v.*: the death of Joseph Warren and the burning of Charlestown. 'Voyage to Boston' was published during the Siege of Boston^{64,65}, which was from April 1775 to March 1776 (a period taking in the death of Joseph Warren). With reference to the 'farthing candle', let it be noted that 'The Adventures of Simon Swaugum' was written before Independence (though certainly only a few years before). More important is that the penny is still, in the 21st Century, a recognised term for a one-cent coin and retailers frequently use the expression 'penny'. One can examine the term 'farthing-candle' by noting from [1] that in eighteenth-century USA even tallow candles cost 9d per pound weight, beeswax candles considerably more. Oak is a not uncommon choice of wood for smoking meat, consistently with the second quotation from 'Simon Swaugum'.

Reference

[1] Crowley J.E. 'The Invention of Comfort: Sensibilities and Design in Early Modern Britain and Early America' JHU Press (2003).

79 Elizabeth Inchbald (1753–1821)



Work cited	Quotations
A Simple Story (published in 1791). Accessible on: https://archive.org/stream/simplestory00inchiala/simplestory00inchiala_djvu.txt	<i>Near four hours after that time (just as the family were going to bed), they came up to the doors of the house, and, rapping violently, gave the alarm of fire, conjuring all the inhabitants to make their way out immediately, as they would save their lives.</i>

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<p>Nature and Art (published in 1796).</p> <p>http://www.gutenberg.org/files/3787/3787-h/3787-h.htm</p>	<p><i>You know, my lord, those people [the labouring classes] never want to dress – shoes and stockings, a coat and waistcoat, a gown and a cap, a petticoat and a handkerchief, are all they want – fire, to be sure, in winter – then all the rest is merely for provision.</i></p> <p><i>It was by the side of this glimmering fire that Rebecca and her sisters told the story of poor Agnes's fate...</i></p>
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The fire referred to in the quotation was actually a non-existent one, but does provide a basis for discussion of what means there were of raising a fire alarm in the late eighteenth century. In the present times of such devices as semiconductors for use in fire detection 'rapping loudly on doors' would not be seen by regulatory authorities as anywhere near sufficient. It was not until the day of Thomas Edison (though more by the efforts of his associates than by those of Edison himself) that fire detectors came into existence. One can imagine that 'rapping on doors' would, in a wealthier household like that in 'A Simple Story', have been accompanied by the use of hand bells. At that time there was legislation relating to fire protection in public buildings [1]. By an Act of Parliament of 1774 public buildings in London were classified for fire risk according to wall thickness and number of storeys and partitioning walls. It is acknowledged in the first quotation from 'Nature and Art' that heating formed a significant part of living expenses for the poorer people of those times. By the time 'Nature and Art' was written domestic heating was by no means the sole combustion application of coal as there were steam engines in operation, perhaps as many as 2000 across England [2]. In the next quotation, why should a particular fire be described as glimmering ('this glimmering fire')? Probably because the structure of the fireplace was composed of something reflective in the visible region of thermal radiation. It is in fact recorded [3] that copper fireplaces were popular in wealthier households in circa 1800, and they if polished would provide a 'glimmer' which in addition to the aesthetic effect diverted radiative heat to the room which might otherwise have been absorbed by a blackened surface to no advantage⁶⁶.

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- [1] <http://www.fire.org.uk/history-of-fire-safety.html>
- [2] <http://www.bl.uk/georgian-britain/articles/the-industrial-revolution>
- [3] <https://scheong.wordpress.com/2013/06/24/flaming-hell-a-history-of-fireplaces-and-fire/>

80 George Crabbe (1754–1832)



Work cited	Quotations
The Village (published 1783).	<i>Lo! where the heath, with withering brake grown o'er, Lends the light turf that warms the neighboring poor;</i>
The Borough (a series of poems published in 1810).	<i>Those far-extended heaps of coal and coke,</i>

Use of peat ('turf') in the first quotation from 'The Village' is in such a way as to emphasise that it was the fuel used in poorer dwellings. By the time Crabbe wrote 'The Borough', 'coal and coke' were part of the scene in urban areas

81 Robert Kerr (1755–1813)

Work cited	Quotations
<p>A General History and Collection of Voyages and Travels (earliest parts published 1811: most published posthumously).</p> <p>Accessible on http://www.gutenberg.org/files/13055/13055-8.txt</p> <p>Kerr was not writing about his own experiences, but drawing on documents and diaries of much earlier travellers including those of members of the East India Company.</p>	<p>With reference to early 17th Century Japan:</p> <p><i>We arrived at Jedo on the 14th September. This city is much larger than Surunga, and much better and more sumptuously built.... In the chief street of the town there is a great cawsay all through from end to end, underneath which flows a river, or large stream of water; and at every fifty paces there is a well-head, or pit, substantially built of free-stone, having buckets with which the inhabitants draw water, both for their ordinary uses and in case of fire.</i></p> <p><i>In the night between the 7th and 8th, the wind rose to a storm of such extreme violence as I had never witnessed... It overturned above an hundred houses in Firando, and unroofed many others... Our house rocked as if shaken by an earthquake, and we spent the night in extreme fear... of perishing along with it by fire; for all night long, the barbarous unruly common people ran up and down the streets with lighted firebrands, while the wind carried large pieces of burning wood quite over the tops of the houses, as it whirled up the burning timbers of the several houses previously thrown down, hurling fire through the air in great flakes, very fearful to behold, and threatening an entire conflagration of the town; and I verily believe, if it had not been for the extreme quantity of rain, contrary to the usual nature of tuffoons [rain storms], that the whole town had been consumed.</i></p> <p><i>I gave orders likewise to get two ladders ready for carrying water to the roof, and provided nine wine casks filled with tempered clay, ready for daubing up the doors of the gadonge, [godown or fire-proof warehouse,] if need should require in consequence of a conflagration</i></p> <p>With reference to Madeira:</p> <p><i>In the year 1420 Zarco began the plantation of Madeira, and being much impeded in his progress by the immense quantity of thick and tall trees,</i></p> <p><i>with which it was then everywhere encumbered, he set the wood on fire to facilitate the clearing of the surface for cultivation. The wood is reported to have continued burning for seven years, and so great was the devastation as to occasion great inconvenience to the colony for many years afterwards, from the want of timber.</i></p> <p>With reference to a location now part of Indonesia, in circa 1511:</p> <p><i>Here they burnt the ship of Serrano⁶⁷, as she was old and rotten.</i></p> <p>With reference to Persia:</p> <p><i>Next...[we] resumed our journey through thick forests and terrible mountains, which continued for two days. In the evening of the 16th, we stopt near a spring, where we remained during the night in the open air, being obliged to light a fire on account of the coldness of the weather, though in the middle of summer.</i></p> <p>With reference to India.</p> <p><i>...as they burnt ten ships belonging to the prefect of Syria⁶⁸, that is the sultan; and destroyed a considerable portion of the city by means of their catapults and, many houses being burnt to the ground, as they are covered with thatch like cottages, and exceedingly combustible.</i></p>

A General History and Collection of Voyages and Travels (cont.).	<p>Relates to an incident in November 1475 – see main text.</p> <p><i>Between us and the shore there was a pool, through which we had to wade, carrying our baggage on our shoulders; and we were almost perished with cold, owing to the wind, and our being drenched with water; yet we unanimously agreed to refrain from making a fire, lest that circumstance might attract the notice of the Tartars, whom we feared to meet with.</i></p> <p>With reference to the Andes close to the Tropic of Cancer.</p> <p><i>There is so great a scarcity of wood in these parts, that the inhabitants use turf or peats for fuel, as is done in Flanders.</i></p> <p>With reference to a part of Lithuania in 1476.</p> <p><i>...we arrived at Trach, a city of Lithuania, we travelled continually in a plain interspersed with some hills, the whole country being covered with wood, and our only lodgings were in miserable hovels; dining always about noon wherever we could meet with a fire, which had been left burning by travellers who had passed before us.</i></p> <p>With reference to a site close to Venezuela in 1497.</p> <p><i>Holding his course westwards along the coast of Paria, he came to the islands called Los Testigos, or the Witnesses, beyond which is the island of Cubagua, where there is a great fishing for pearl-muscles, and where also there is a well of rock oil.</i></p>
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Jedo became the modern Tokyo and the bucket-based firefighting would at that time have had its equivalent in London. ‘Firando’ is the modern Hirado (and had previously been known as that) [1]. Natural extinguishment of an urban fire by a downpour is like extinguishment of a forest fire by rainfall, discussed previously in this book when the work of Sarah Fielding was being analysed. This part of Kerr’s work abounds in anecdotes of burning property, building and ships. The first two quotes in the table were selected because of their overlap with points made previously in this book. The third does introduce a new ‘combustion topic’. Gadonge and godown are one-and-the-same word meaning a storage enclosure, and the process of ‘daubing’ with ‘tempered clay’ was a fire protection measure at the time of the narrative. ‘Daub’ is used as a verb above, but is also a noun as in ‘wattle-and-daub’. This same substance which is one component of a major building material of the past was also used to coat susceptible articles or parts of buildings to make them fire-resistant. It is made by firing clay in a kiln. There was nothing at all new about it at the time of its reported use in ‘A General History and Collection of Voyages and Travels’: daub was used in building in Roman times [2]. We can conclude almost for certain that the clay used at the ‘gadonge’ was local⁶⁹.

The fires in Madeira that lasted for seven years are recorded in numerous sources (e.g. [3]). Kerr reports that the lack of timber they caused was a serious disadvantage. Sometimes a different slant is put on it: that the availability of large tracts of cleared land was to the benefit of the expanding community. The burning of a ship in the next quotation can be analysed with interest. The exploration originated from Portugal, possibly via Goa, so why was an ‘old and rotten’ vessel sent such a long distance in the first place? Has the narrator got his facts quite straight here? Reference [4] reports that in 16th century Portugal short cuts were often taken in ship building, including the use of wood not adequately seasoned, and that this sometimes caused shipwrecks on a maiden voyage! So maybe it was this sort of defective quality control in building rather than age and rot that made Serrano’s vessel a candidate for incineration. Reference [4] is chiefly concerned with Goa: the present-day Indonesia is of course much further east still. The need for a fire for comfort in the next quotation is obviously a simple altitude effect; the explorers were in ‘terrible mountains’. With altitude, heat from the emissive earth’s surface is attenuated so swings in temperature between day and night are greater. The matter of the vulnerability of thatched residences to fire in English settings has featured more than once in the present book, and is referred to in India in the next quotation. Use of the adjective ‘combustible’ is interesting.

The next quotation describes the aftermath of a shipwreck of a voyage which had begun at Derbent, where temperatures would have been above freezing at that time of year, notwithstanding the rueful tone of the quotation. With reference to the next quotation, the Andes are known across their expanse to have peatlands. The region referred to in the quotation is in the tropical Andes and noted by Kerr as being ‘high and rugged, and barren in some places, without trees or even grass’. In Lithuania by contrast (next quotation) there was plenty of wood, and it is interesting that a group having themselves finished using a cooking or heating fire would leave it alight for the possible use of someone (unknown to them, obviously) following.

There was of course knowledge and indeed exploitation of crude oil long before the 'oil industry' began in the mid 19th Century and the rock oil referred to in the next quotation would have been crude oil. Note that almost since the oil industry came into being Venezuela has had a major part in it, and was one of the founding members of OPEC in 1960. This was anticipated in 1497 in the quotation given, and it is interesting that the term 'rock oil' was applied. 'Petroleum' means just that – 'rock oil' – and was coined in the early 15th Century [5] so would have been part of Kerr's vocabulary.

This highly interesting mention of oil is both a climax in this study of Kerr's work and a suitable place at which to draw a line under it. That Kerr's set of volumes are filled with points relevant to the present book is clear.

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- [1] <http://www.city.hirado.nagasaki.jp/english/history/historycontent.htm>
- [2] https://books.google.com.au/books?id=rAahCgAAQBAJ&pg=PA14&lpg=PA14&dq=d&aub+fire+protection&source=bl&ots=DRjWLBCBKT&sig=9AgbyiS80p8pTAMaQ1XR_CXNdz9Y&hl=en&sa=X&ved=0CB8Q6AEwAGoVChMI-sGqh_W7yAIVgRqmCh3-wYW#v=onepage&q=daub%20fire%20protection&f=false
- [3] <http://www.intowine.com/madeira.html>
- [4] Mathew K.M. 'History of the Portuguese Navigation in India, 1497–1600' Mittal Publications (1988).
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82 William Blake (1757–1827)



Work cited	Quotations
<p>Jerusalem The Emanation of the Giant Albion (written in parts over the period 1804 to 1820).</p> <p>Accessible on: http://www.blakearchive.org/exist/ blake/archive/erdman.xq?id=b1.16</p>	<p><i>There is the Cave; the Rock; the Tree: the Lake of Udan Adan: The Forest, and the Marsh, and the Pits of bitumen deadly: The Rocks of solid fire: the Ice valleys: the Plains of burning sand; the rivers, cataract & Lakes of Fire</i></p> <p><i>The hour-glass contemnd because its simple workmanship. Was like the workmanship of the plowman, & the water wheel, That raises water into cisterns: broken & burnd with fire:</i></p>
<p>The Chimney Sweeper from a collection of poems entitled 'Songs of Innocence and Experience' (published 1789).</p> <p>Accessible on: http://www.gutenberg.org/ files/1934/1934-h/1934-h.htm</p>	<p><i>As Tom was a-sleeping, he had such a sight! That thousands of sweepers, Dick, Joe, Ned, and Jack, Were all of them locked up in coffins of black.</i></p>
<p>The French Revolution (written in 1791). http://www.bartleby.com/235/254.html</p>	<p><i>Then the ancientest Peer, Duke of Burgundy, rose from the Monarch's right hand, red as wines</i></p> <p><i>From his mountains; an odour of war like a ripe vineyard, rose from his garments</i></p>

The first of the quotations from Blake is very rich in imagery from fire. Pitch has been mentioned several times in this book as belonging to periods well before Blake's, but there is a further relevant point. 'Jerusalem The Emanation of the Giant Albion' was written at just the time coal retorting was becoming prevalent, and would have been in the news a great deal, so an educated and alert man like Blake would have had knowledge of pitch. Blake would also have known of the pitch deposit in Trinidad, described in the coverage herein of the work of John Smith. The 'rocks of solid fire' and burning sand, whatever poetic use Blake intended, also have natural explanations if one chooses to invoke them. It was not until about 20 years after Blake's lifetime that oil shale was put to use as the basis of liquid fuels, in countries including Scotland and France. The combustible component of oil shale is kerogen, and if rock containing it is heated there will be ignition and flaming. That was observed in the US in circa 1870 and reported in 'Scientific American' at the time. Had there had been earlier such incidents having been reported only orally, therefore becoming anecdotal and having reached the ears of men like Blake? This on thoughtful consideration seems highly probable. And the 'burning sand'? 'Oil sands' were known to the First Nation people in Canada in the early 18th Century and such information, without details of combustion behaviour which would not at that time have been known, would nevertheless have stimulated the minds of interested men and women.

It is emphasised that the above paragraph is in no way an attempt to 'explain away' Blake's poetic utterances: it is simply a reflection of how they can have been supported – even enhanced – by his knowledge of natural phenomena. Similarly moving on to the second of the quotations, Blake is probably thinking not of domestic water heating but of steam engines: the word 'cistern', in its sense of a receptacle for water, was often used in relation to steam engines as well as in relation to domestic installations, e.g. [1]. And the action of 'breaking and burning by fire' would have been with coal as the fuel.

That there had been chimney sweeps in London before Shakespeare's time, therefore longer still before Blake's, has been noted in this book, and this is relevant to the second row in the table on Blake. Reference [2] gives a full account of the exploitation of boys which obtained in the chimney sweep trade in the 18th century. Boys were of course sent up chimneys, and as well as soot, which could be dislodged with a brush, there was tar which had to be removed by means of a metal scraper. Their accommodation was grim: Blake says, a few lines earlier than those quoted:

So your chimneys I sweep, and in soot I sleep.

That is a plain statement of fact: the boys did sleep on sacks having previously been filled with soot and still containing a residual amount [2]. The soot was saleable as a fertiliser, reflecting the primitive combustion conditions. Its valuable ingredients as a fertiliser were the sulphur and the nitrogen which, in complete burning, would have been converted to gases and exited the chimney that way. Nowadays these are major issues in the protection of the atmosphere. Even so soot still has possible application to horticulture.

With reference to the next column, the 'odour of war' presumably means the smell of spent gunpowder and this can be discussed scientifically in fairly simple terms. Quite simply, a small amount of the nitrogen in the saltpetre constituent goes to ammonia. Ammonia has a low odour threshold and the very minor amount yielded in gunpowder use can be picked up by sense of smell without difficulty in gunpowder usage when it also (as reported in the quote) is absorbed by fabric in clothing. The amount of ammonia yielded is limited by the low hydrogen content of the charcoal ingredient. There is another source of the 'odour of war' from gunpowder: sulphur dioxide from the sulphur content. This too had a low odour threshold.

References

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- [2] <http://www.ruchalachimney.com/history.html>



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83 Mary Robinson (1757–1800)



Work cited	Quotations
<p>Nobody: A Comedy in Two Acts (first performed 1794)</p> <p>Accessible on https://www.rc.umd.edu/editions/ nobody/HTML/nobody</p> <p>↑</p> <p>This source contains some extremely useful notes which have been drawn on in what follows.</p>	<p><i>NELLY: I'll go fetch a lighted Match, or a burnt Feather</i> [to the bedside of someone unconscious]</p>
<p>Golfre, Gothic Swiss Tale (from 'Lyrical Tales', published 1800).</p> <p>Accessible on: http://www.poemhunter.com/ best-poems/mary-darby-robinson/ golfre-gothic-swiss-tale/</p>	<p><i>They sat beside their faggot fire...</i></p> <p><i>The Castle-turrets seem'd to blaze...</i></p> <p><i>The drawbridge now was all on fire,</i></p> <p><i>The moat foam'd high, with furious ire, Against the black walls dashing.</i></p>

A lighted match was seen as a way of reviving someone from an unconscious state, and (even less realistically) 'burnt feathers' as a way of restoring thought and speech⁷⁰. As its title suggests 'Golfre, Gothic Swiss Tale' is set in Switzerland, and at a time well predating Mary Robinson's own. The use of 'fagots' as domestic fuel is altogether consonant with this.

Much more dramatic is the account of the fire at a castle. A present-day fire expert can see deduce quite unequivocally from this description a phenomenon in fire spread, and its recording in the poem is remarkably accurate. A great deal has been said about the identity or otherwise of black-body behaviour with black colour, but broadly speaking a black surface will be more emissive towards thermal radiation than one which is less 'black', say the rather neutral colour of much masonry. At the fire in the castle described in 'Golfre, Gothic Swiss Tale' the castle walls, as well as being heated by the nearby fire at the drawbridge, had become black through smoke deposition. This had made them more powerfully radiating, some of the heat so radiated being intercepted by previously unaffected parts of the drawbridge/castle structure and causing them to ignite. What Mary Robinson wrote in c. 1800 is a text-book case of what fire protection engineers now call 'radiation enhancement'. It could not of course have been analysed in those terms at the time that the poem was written⁷¹, probably not until some time into the 20th Century. But that the observations had been made long before then is the point of interest, totally consistently with the aspirations of the present author in preparing this text.

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84 Ryokan (1758–1831)



Work cited	Quotations
From Ref. [1].	<p><i>An iron pot, my rice-cooker, has some kitchen dust. My hollow furnace is seldom heated by cooking-fire.</i></p> <p><i>Bent under a pile of firewood, I walk down a hill.</i></p> <p><i>Then I build a fire with branches still bearing leaves.</i></p> <p><i>...men gathering dry firewood are all I can see here.</i></p> <p><i>By my fireplace, a bundle of dry branches to keep me warm.</i></p> <p><i>Out on the sandy beach of Suma, known as a gull's brother, I rake salty seaweeds together and, blowing, build a fire,</i></p> <p>Ryokan was a poet in the Zen tradition. He wrote Japanese and Chinese poetry.</p>

The first quotation is part of Ryokan's description of his very austere hermitical home. The following quotation suggests that he did allow himself heating by a wood fire. His hermitage was in Tamashima where in the winter temperatures are around 5°C [2]. From the third quotation emerges a point which was unimportant if the wood was being burnt immediately but relevant in general to wood combustion: wood seasons more rapidly if the leaves are left on it. Yet why does he specify 'dry firewood' in the next quotation? The same issue arises in the next quotation. Seaweed can of course be burnt (next quotation). Other references to fire in Ryokan's poems are of the same nature, referring to his very basic domestic way of life. Close observation of such prosaic things and their incorporation into verse having profundity is in some degree the craft of the poet.

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- [1] Yuasa N. 'The Zen Poems of Ryokan' Princeton University Press (1981).
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85 Robert Burns (1759–1796)



Work cited	Quotations
<p>Verses on The Destruction of The Woods Near Drumlanrig</p> <p>Accessible on: http://www.rampantscotland.com/poetry/blpoems_drumlanrig.htm</p>	<p><i>...was't the wil'fire scorch'd their boughs?</i></p>
<p>Impromptu on Carron Iron Works (written 1787).</p> <p>Accessible on: http://www.robertburns.org/works/176.shtml</p>	<p><i>We cam na here to view your warks, In hopes to be mair wise, But only, lest we gang to hell, It may be nae surprise: But when we tirld' at your door Your porter dought na hear us; Sae may, shou'd we to Hell's yetts come, Your billy Satan sair us.</i></p>
<p>Halloween (written 1785).</p> <p>Version in modern English accessible on: http://www.mythicjourneys.org/mythkids_oct06_burns.html</p>	<p><i>Some merry, friendly, country-folks, Together did convene, To burn their nuts...</i></p>
<p>The Twa Dogs (‘Tale’ written in 1786).</p> <p>Accessible on: http://www.robertburns.org/works/86.shtml</p>	<p><i>Our laird [estate owner] gets in his racked rents, His coals, his kane, an' a' his stents</i></p>

<p>Epistle To Hugh Parker (written 1788).</p> <p>Accessible on: http://www.robertburns.org/works/222.shtml</p>	<p><i>The red peat gleams, a fiery kernel. And nought but peat reek [smoke] i' my head</i></p>
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Burns is speaking in 'Verses On The Destruction Of The Woods Near Drumlanrig' of woodland destruction in a particular part of south west Scotland in the late 18th Century. The woods were on a private estate. His visit to the iron works at Carron near Falkirk took place on Sunday 26th August 1787 [1] and a little later the works was used to make weapons for the Napoleonic wars. When the ironworks was set up in 1759 [2] it used as a metallurgical fuel coke made from local coal: charcoal would have been much more common at that time⁷². There was therefore a blast furnace in central Scotland in the mid 18th Century. It was not Burns' way to comment on details of this sort, but all of this can legitimately be related to his 'Impromptu'.

Halloween if of course the 31st October and was a day of festivity at the period under discussion. We are informed in [3] of what 'burning nuts' means in Burns' poem. Hazelnuts were thrown on to a fire by participants in the festivity, and this became the basis of what might be called a party game. The fire would have used coal as fuel. As noted this was not scarce in Scotland by Burns' time.

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‘The Twa dogs’ is said to be set in Ayrshire [3]. Ayrshire is abundant in coal, and the remark quoted from ‘The Twa Dogs’ means that the laird drew royalties on any coal from them. This is made crystal clear in [4] which says:

Prior to 1938 the ownership of coal royalties in the United Kingdom had been held by those who owned the surface of the land below which the coal was vertically situated⁷³.

There had been coal production in Ayrshire at least since 1675 [5] so that people like ‘Our Laird’ had been benefiting financially from it for a long time by Burns’ day is clear.

That ‘peat’ occurs twice in the ‘Epistle To Hugh Parker’ stimulates enquiry into the extent of fuel use of peat in Scotland at that time. Without doubt not only in Scotland but across the British Isles peat was used as a household fuel in Burns’ time and, especially in isolated areas including Cornwall, for some time after that. In Scotland in Burns’ day peat was the fuel used by distillers, both in preliminary drying of the cereal and in heating the stills [6]. In his ‘Epistle to J. Lapraik’ written in 1785 Burns says:

*Gie me ae spark o’ nature’s fire,
That’s a’ the learning I desire;
Then tho’ I drudge thro’ dub an’ mire
At pleugh or cart,
My muse, tho’ hamely in attire,
May touch the heart.*

The term ‘Nature’s fire’ has become part of the Burns lore in his beloved Scotland. Peat sometimes burns *in situ*, and one need not go back to Burns’ day for incidences of this. Such a fire in a Scottish National Park in 2006 lasted for over a month [7] and such a phenomenon would surely have been known to Burns. One need not assert that that was what meant by ‘nature’s fire’ in the above verse (although it certainly might have been: Burns was describing experiences on the land, and ‘dub’ means ‘wet earth’) to link the expression meaningfully with the natural burning of peat in its bed-moist state. The Scottish milieu and ethos are common to both. Burning of peat in this way is slow, because of the moisture content and the compaction of the peat.

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- [3] <https://au.answers.yahoo.com/question/index?qid=20110418111631AA1lctY>
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- [5] <http://www.scottishmining.co.uk/155.html>
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- [7] [http://www.heraldscotland.com/news/13124203.Peat wildfires are linked to climate change/](http://www.heraldscotland.com/news/13124203.Peat_wildfires_are_linked_to_climate_change/)

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86 Mary Wollstonecraft (1759–1797)



Work cited	Quotations
<p>Letters written during a short residence in Sweden, Norway, and Denmark (published 1796).</p> <p>Accessible on: http://www.gutenberg.org/ files/3529/3529-h/3529-h.htm</p>	<p><i>The view, immediately on the left, as we drove down the mountain, was almost spoilt by the depredations committed on the rocks to make alum. I do not know the process. I only saw that the rocks looked red after they had been burnt, and regretted that the operation should leave a quantity of rubbish to introduce an image of human industry in the shape of destruction.</i></p> <p><i>On inquiry, however, I learnt that some years since a forest had been burnt. This appearance of desolation was beyond measure gloomy, inspiring emotions that sterility had never produced. Fires of this kind are occasioned by the wind suddenly rising when the farmers are burning roots of trees, stalks of beans, &c, with which they manure the ground. The devastation must, indeed, be terrible, when this, literally speaking, wildfire, runs along the forest, flying from top to top, and crackling amongst the branches. The soil, as well as the trees, is swept away by the destructive torrent; and the country, despoiled of beauty and riches, is left to mourn for ages.</i></p> <p><i>I had often heard the Danes, even those who had seen Paris and London, speak of Copenhagen with rapture. Certainly I have seen it in a very disadvantageous light, some of the best streets having been burnt, and the whole place thrown into confusion.</i></p> <p><i>But if for a moment she looked pleased, she still resembled a heap of combustible matter, to which an accidental spark might set fire;</i></p>
<p>Original Stories from Real Life (published 1788).</p> <p>Accessible on: http://www.gutenberg.org/ files/36507/36507-h/36507-h.htm</p>	<p><i>But if for a moment she looked pleased, she still resembled a heap of combustible matter, to which an accidental spark might set fire;</i></p> <p><i>They ran into the cottage; the poor woman who lived in it, sent her children for wood, and soon made a good fire to dry them.</i></p>
<p>Maria, or The Wrongs of Woman (published 1798).</p>	<p><i>...leaned my head against the marble chimney-piece, and gazing on the evergreens that filled the fire-place...</i></p>

The first quotation clearly relates to the production of alum from the mineral alunite (although it was not known as that until later than the ‘letters’ being considered) by heating (‘calcination’) [1]. Once a tree is felled the stump can become unsightly and is better burnt, a practice still routinely followed [2]. In the narrative it sounds as if saltpetre is being added to the roots before burning. Whatever, a bulky tree root takes days to burn out completely and the mishap referred to was due to acceleration of combustion by enhanced air supply. The third quotation relates to the Great Fire of Copenhagen in 1795 [3]. It began at a naval base and was helped to spread by such materials as rope.

In the first quotation from ‘Original Stories from Real Life’ the sense is figurative but the example from fire science realistic enough. Wollstonecraft was born in London and, additionally to the journeys in the ‘letters’ analysed above, had lived in Ireland for a period. A pile of vegetation is an obvious example of a ‘heap of combustible matter, to which an accidental spark might set fire’. Had that come within her experience? There was plenty of coal in London at that time, but a lump of coal would not be ignited by a transient spark: coal dust dispersed in the air might. There are other more obvious examples which might have influenced her. At the time the work was written there were about 200 regular newspapers and periodicals on sale in London. A stockpile of these in a home would constitute a considerable fire load. It was just at the time that ‘Original Stories from Real Life’ was written that paper bags for food came into use in London. They when contaminated with the food they had contained would have been fire hazard. Paper bags replaced cloth ones which were probably laundered for re-use [4]. If not all of the grease contaminants had been removed in laundering, the drying would have been a fire hazard⁷⁴. Wollstonecraft was probably thinking of such things. The next quotation has the implication that wood was used as fuel in a household which could not afford coal. A point of some interest emerges in the quotation from ‘Maria’: evergreen trees were (are) seen as providing ash more suitable for readmission to the ground than some deciduous trees are. It is not quite that simple, and depends on what sort of trees are being cultivated. But that clearly is the reason for use of wood from evergreen trees in the narrative under discussion.

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- [2] <http://www.treeremoval.com/stump-removal/how-to-burn-or-rot-a-tree-stump-naturally/#.VhGUJm8w-Uk>
- [3] ‘Copenhagen: People and Places’ Gyldendal, Copenhagen (2006).
- [4] <http://woodsrunnersdiary.blogspot.com.au/2012/03/thoughts-on-18th-century-food-packaging.html>

87 William Beckford (1760–1844)



Work cited	Quotations
<p>The History of the Caliph Vathek. Written by Beckford in French in 1786. Translated into English by Samuel Henley (1740–1815) in 1787. Accessible on: http://www.gutenberg.org/files/2060/2060-h/2060-h.htm</p>	<p><i>Speak, said he, where are we? do you not see those spectres that are stirring the burning coals?</i></p> <p><i>The Palace of Perfumes, which was termed likewise the Incentive to Pleasure, consisted of various halls, where the different perfumes which the earth produces were kept perpetually burning in censers of gold. Flambeaux and aromatic lamps were here lighted in open day.</i></p> <p><i>...they, however, went on, and observed an infinity of censers, in which ambergris and the wood of aloes were continually burning; between the several columns were placed tables, each spread with a profusion of viands, and wines of every species sparkling in vases of crystal.</i></p> <p><i>One of the forests of cedar that bordered their way took fire, and the branches that overhung the path, extending their flames to the muslins and chintzes which covered the cages of the ladies, obliged them to jump out, at the peril of their necks.</i></p> <p>An Arabian setting in the 6th–7th century AD.</p>

The studies of Wace *q.v.* on King Arthur are set in the 5th and 6th Centuries AD, so that 'coals' should appear in 'The History of the Caliph Vathek' is not that surprising. Coal had been exported from England long before the 6th century AD as previously noted and could of course be taken further east via the Mediterranean. The coal in the literature under discussion might have been imported, or it might have been from a small local pit from where coal could be extracted with very basic implements. It is often not realised that small deposits of coal which in today's world, or two centuries earlier, would not be seen as worth developing are ubiquitous and sometimes served their turn at periods as long ago as that of the setting of 'The History of the Caliph Vathek'.

Flambeaux (following quotation) have featured in other literature in the present book, that of Ann Radcliffe and that of Lady Mary Wortley Montagu. They'd have been common enough in the time of William Beckford, who is however stating that they were in use a millennium earlier. 'Flambeau' simply means 'flame' and that such were used for illumination and adornment at the period under discussion is without question, so Beckford is on quite solid ground⁷⁵. The gorgeousness of centres of such places as palaces at that time and in that era is made very clear in the quotation. That it depended on 'combustion' is also clear. Such luxuriance continues into the content of the next quotation. The burning of 'the wood of aloes' as a means of generating fragrance predates even the period under discussion: it occurs twice in the Old Testament⁷⁶.

Place names within 'Arabia' have changed over the centuries, but 'Arabia' in 'The History of the Caliph Vathek' corresponds to the landmass we now refer to by that name. Muhammed was born at Mecca in circa 570 BC [1], the period of the setting of the writing under consideration. The experience in the fourth and final quotation in the above table was repeated in 2005 when there was a major forest fire in Saudi Arabia [2]. A thousand hectares of forest were lost.

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88 Susanna Rowson (1762⁷⁷–1824)



Work cited	Quotations
Charlotte Temple (published 1790). Accessible on: http://www.gutenberg.org/ files/171/171-h/171-h.htm	<p><i>One night when he was upon guard, a dreadful fire broke out near Mr. Franklin's house, which, in a few hours, reduced that and several others to ashes; fortunately no lives were lost, and, by the assiduity of the soldiers, much valuable property was saved from the flames.</i></p> <p style="text-align: center;">↑ Occurred in New York.</p>

The fire behaviour in the first quotation from 'Charlotte Temple' is straightforward enough. What puzzles the exegete is the reference to 'soldiers'. Mr Franklin's property, which we are informed was large and included lands, was probably out of town some distance from the central commercial district. At that very time large numbers of American ex-servicemen from the War of Independence were living in locations similarly distanced from New York City. This was under the terms of the Military Tract of Central New York, and such locations developed into townships with amenities. That the 'soldiers' referred to by Rowson were residents of these settlements is a plausible conjecture, although there is nothing in the book enabling it to be more than that. One might however reason another way. The War of Independence was over by then, and there'd have been no servicemen on either side stationed in NY beyond the regular peacetime contingent who would not have been free to direct their efforts at the fire fighting except under superior orders.

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- [2] <http://www.rootsweb.ancestry.com/~nycayuga/land/mtracths.html>

89 Ann Radcliffe (1764–1823)



Work cited	Quotations
The Italian (published 1797).	<p>From Chapter 1. <i>The night was still, and they now heard, for the first time, murmurs as of a distant multitude; and then the sudden splendor of fireworks broke upon the sky. These arose from a villa on the western margin of the bay, and were given in honour of the birth of one of the royal princes.</i></p> <p>From Chapter 6. <i>...but if he had been as airily dressed as yourself, Signor, he might have been just as well concealed; for that dusky aisle is lighted only by one lamp, which hangs at the end next the painted window, except when the tapers at the shrine of San Antonio happen to be burning at the other extremity, and even then the place is almost as gloomy as this vault.</i></p> <p style="text-align: center;">↑ There are other examples of religious use of tapers in the book.</p> <p>From Chapter 16. <i>The Corso, through which they were obliged to pass, was crowded with gay carriages and marks, with processions of musicians, monks, and mountebanks, was lighted up with innumerable flambeaux...</i></p> <p>From Chapter 17. <i>Where is my bed? said the afflicted Ellena, fearfully as she looked round. It is there on the floor, replied Spalatro... If you want the lamp, he added, I will leave it, and come for it in a minute or two.</i> <i>Will you not let me have a lamp for the night, she said in a supplicating and timid voice. For the night! said the man gruffly; What! to set fire to the house.</i></p> <p>From Chapter 22. <i>but, at last, he came to a room where there was some fire not quite out, upon the hearth, and he went up to it, to warm himself... ...but the fire gave such a poor light, he could not see whether any body was there. So he stirred up the fire, and tried to make it blaze a little...</i></p> <p>From Chapter 26. <i>The lights burn dimly, said he, I cannot distinguish these faces. It was ordered that a lamp should be lowered from the roof.</i></p>

The Romance of the Forest (first published in 1791).	<i>A fire was kindled on a hearth, which it is probable had not for many years before afforded the warmth of hospitality; and Peter having spread the provision he had brought from the coach, La Motte and his family, encircled round the fire, partook of a repast, which hunger and fatigue made delicious.</i>
The Castles of Athlin and Dunbayne (published 1789).	<i>...while some of the ruffians hastened to light a fire of the heath and sticks they could pick up.</i>
The Mysteries of Udolpho (published 1794).	<i>On turning the angle of a mountain, a light appeared at a distance, that illumined the rocks, and the horizon to a great extent. It was evidently a large fire, but whether accidental, or otherwise, there were no means of knowing. St. Aubert thought it was probably kindled by some of the numerous banditti, that infested the Pyrenees, and he became watchful and anxious to know whether the road passed near this fire.</i>
Set in 1584 in southern France.	<i>She saw his vast armies winding among the defiles, and over the tremendous cliffs of the mountains, which at night were lighted up by his fires, or by the torches which he caused to be carried when he pursued his indefatigable march.</i> <i>She now retired to her bed, leaving the lamp burning on the table; but its gloomy light, instead of dispelling her fear, assisted it; for, by its uncertain rays, she almost fancied she saw shapes flit past her curtains and glide into the remote obscurity of her chamber.</i>



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In the first quotation from 'The Italian' there is yet another reference to the observance of a major event by means of a fireworks display; such feature many times in the present book. Tapers and lamps for ecclesiastical use at this time (second quotation) would have been beeswax, though because of the high cost of this cheaper materials including spermaceti were used to fabricate candles for 'secular' use [1] (see also the discussion of the work of Henry Fielding). The flambeau (next quotation) has been described in the discussion of Shakespeare's 'Merry Wives of Windsor'. The discussion over the 'lamp' from Chapter 17 continues beyond what is quoted. Fire safety rather than economy would have been the decisive factor if the bed was upholstered with straw consistently with the otherwise very basic nature of the room, of which the reader is informed.

Every impression is given in the quotation from Chapter 22 that 'the fire' was a coal fire. At that time English coal was exported to Italy [2]. In the next quotation, clearly one candle from the array constituting a chandelier was removed⁷⁸.

The first quotation from 'The Romance of the Forest' is part of a description of an entry into a long uninhabited abbey. Here is a theme which recurs so abundantly not only in literature but, more importantly, in the minds of men and women: that the light and heat from a fire restore what had previously been absent through lack of human presence. Fairly obviously this particular fire was wood: those entering the abbey, which was in an arboreal setting, would not have been carrying coal! Requisitions from the nearest town made the abbey more suitable for residence, and these included candles. 'The Castles of Athlin and Dunbayne' relates to the Scottish Highlands: heath fires in such a location have been discussed elsewhere in this book, for example when the work of Samuel Taylor Coleridge was being considered.

With reference to the first of the quotations from 'The Mysteries of Udolpho', we simply note that natural fires are common in the Pyrenees so St. Aubert was possibly being needlessly suspicious. In examining the matter of the 'torches' in the next quotation, we invoke the discussion of torches discussed under the work of Francis Bacon, whose lifespan takes in the year in which the novel is set. There it was emphasised that the flame of the torch was, unlike that of a Bunsen burner or as modern cooktop gas appliance, non-premixed. In Robert Burns' 'Waverley', published in the early 19th Century, pine branches were being used as torches. Very probably those in 'The Mysteries of Udolpho' were something this basic. An antithesis to the view expressed above that a fire engenders emotional as well as physical warmth is contained in the next quotation.

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90 Maria Edgeworth (1768–1849)



Work cited	Quotations
Castle Rackrent (first published 1800). Accessible on: http://eremita.di.uminho.pt/gutenberg/1/4/2/1424/1424-h/1424-h.htm	<p><i>Well, and if there's no turf to be had in the town or country, why, what signifies talking any more about it; can't ye go and cut down a tree?</i></p> <p><i>'And what do you call that, Sir Kit?' said she; 'that – that looks like a pile of black bricks, pray, Sir Kit?'</i></p> <p><i>'My turf-stack, my dear,' said my master, and bit his lip.</i></p> <p><i>Where have you lived, my lady, all your life, not to know a turf-stack when you see it?</i></p> <p>Set in Ireland.</p>

In the first of the above quotations, peat ('turf') having been confirmed to be unavailable a tree was to be used as fuel instead. This point is addressed remarkably precisely in [1], in which it is recorded that peat and imported coal had replaced firewood in Ireland by the time the book was written and that the former was rapidly depleting. Even so there was a shortage of firewood because of the need for charcoal to make domestic iron, eliminating the need for import from England of that. A turf stack is of course a stockpile of peat having been cut out of the ground. The short shelf life of such a stockpile is probably what prevented incidences of spontaneous heating such have been discussed herein in relation to hay. There'd have been enough water in the peat to remove spontaneous heating effects by evaporation over the period between assembly of the stack and its dismantling for fuel use. That peat of low moisture content can display spontaneous combustion is not in doubt.

Reference

[1] Keenan D. 'Eighteenth Century Ireland 1703-1800 Society and History' XLibris Corporation (2014).

91 Napoleon Bonaparte (1769–1821)



Work cited	Quotations
<p>Letters to Josephine, 1796–1812.</p> <p>Translation accessible on: https://archive.org/stream/napoleonsletters00napoiala/napoleonsletters00napoiala_djvu.txt</p>	<p>Ebersdorf, May 29 1809, 7 p.m. <i>I have been here since yesterday; I am stopped by the river. The bridge has been burnt; I shall cross at mid-night.</i></p> <p>Marmirolo, July 19, 1796. <i>We attacked Mantua yesterday. We warmed it up from two batteries with red-hot shot and from mortars. All night long that wretched town has been on fire. The sight was horrible and majestic.</i></p>

The ‘burnt bridge’ relates to the battle of Aspern-Essling, which took place on 21st–22nd May 1809 [1]. The bridge referred to as having been burnt was across the Danube. The ‘Siege of Mantua’, the subject of the second quote from Napoleon’s correspondence with his beloved, took place from 1796–1799 [2]. Reference [3] has this to say about it:

The most dreadful fire was now night and day with unrelenting fury continued

and this corresponds in time to the early part of the siege, as does Bonaparte’s description of it in the table.

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- [2] http://www.napoleon.org/en/magazine/just_published/files/484855.asp
- [3] Forshaw H. ‘A description of the town and fortress of Mantua’ (translated from German) William Jones, London (1797).

92 William Wordsworth (1770–1850)



Work cited	Quotations
<p>Composed upon Westminster Bridge (written 3rd September 1802).</p> <p>Accessible on: http://www.poetryfoundation.org/poem/174783</p>	<p><i>This City [London] now doth, like a garment, wear The beauty of the morning; silent, bare, Ships, towers, domes, theatres, and temples lie Open unto the fields, and to the sky; All bright and glittering in the smokeless air.</i></p>
<p>Goody Blake and Harry Gill (first published in 1798).</p>	<p><i>By the same fire to boil their pottage Two poor old Dames as I have known Will often live in one small cottage.</i></p>
<p>Ode Composed on a May Morning (written in 1826).</p> <p>Accessible in sources including [1].</p>	<p><i>Where cities fanned by thy brisk airs Behold a smokeless sky...</i></p>
<p>'Tis Said that Some have Died for Love (written c. 1800).</p> <p>Accessible on: http://genius.com/William-wordsword-tis-said-that-some-have-died-for-love-annotated</p>	<p><i>O move though cottage from behind that oak! Or let the aged tree uprooted lie That in some other way yon smoke May mount into the sky!</i></p>

Before considering Wordsworth's apparently quite extraordinary description of London in 1802 that we note that 3rd September 1802 was a Friday, which one might intuitively expect to be the worst day of the week for atmospheric pollution at a time when London was appallingly polluted: industrialisation had begun without attention to consequences on the environment or indeed the safety of workers. The first 'factory act' was not to follow for several decades.

Quite simply Wordsworth, writing early in the morning when many domestic coal fires had been out of service for several hours, responded with his poetic instincts to the beauties of urban London including Wren's St. Paul's Cathedral which was in use and approaching completion at that time. An insight into Wordsworth's expression of the sight of London might be understood from the following rough analogy. The present author is one of tens or hundreds of millions who have admired the architecture of the railway station in Mumbai (Bombay), which belongs to the era of Imperial India. One can only do so under conditions of atmospheric hygiene well below those which would obtain say in the UK or Australia, but one is not preoccupied with that.

The quote from 'Goody Blake and Harry Gill' at first suggests an eminently sensible and economic domestic arrangement. (In 1970s England when students surviving on modest grants sometimes had to live in insalubrious city housing, it was customary for the residents of such a dwelling to do their cooking at the same time. That was not in order to have a shared meal but to keep gas and electricity costs down.) Coal was used for cooking in Scotland at the time Wordsworth wrote 'Goody Blake and Harry Gill', and when people live from hand to mouth effectively to halve the cost of a household requisite can make a major difference.

We are informed in [1] that the inspiration of 'Ode Composed on a May Morning' was the Vale of Newlands in South Wales which Wordsworth visited at that time. This is a few miles from Cardiff which, in 1826 when Wordsworth wrote the 'Ode', had a population of about 6000, and manufactured from local coal gas for street lighting [2]. Nearby Merthyr Tydfil was a major iron producer long before then (also, of course, dependent on the local coal industry) and the iron was exported from the Port of Cardiff. In other words the quotation from 'Ode Composed on a May Morning' is contrasting the air quality (as we'd now call it) of the Vale of Newlands with that of the highly industrialised Cardiff close by, and even hinting at natural ventilation of the latter by the former! The longevity of oak trees features in the discussion herein of the work of Thomas Carew, Edmund Spenser and John Donne: Wordsworth refers to it in the quotation in the following row.

References

- [1] William Wordsworth The Complete Poetical Works of William Wordsworth: 1823–1833 Cosimo Inc. (2008).
- [2] <http://www.localhistories.org/Cardiff.html>

93 Sir Walter Scott (1771–1832)



Work cited	Quotations
<p>Waverley (written in 1814).</p> <p>Accessible on: https://www.gutenberg.org/files/5998/5998-h/5998-h.htm</p>	<p><i>...like a fire to heather set, that covers a solitary hill with smoke, and illumines it at the same time with dusky fire.</i></p> <p><i>Accordingly, in full expectation of these distinguished guests, Luckie Macleary had swept her house for the first time this fortnight, tempered her turf-fire to such a heat as the season required in her damp hovel even at Midsummer...</i></p> <p><i>They entered a very long range of stables; in every stall stood a coal-black horse...</i></p> <p><i>This legend, with several variations, is found in many parts of Scotland and England. The scene is sometimes laid in some favourite glen of the Highlands, sometimes in the deep coal-mines of Northumberland and Cumberland, which rim so far beneath the ocean.</i></p> <p><i>The interior of the cave, which here rose very high, was illuminated by torches made of pine-tree, which emitted a bright and bickering light, attended by a strong though not unpleasant odour. Their light was assisted by the red glare of a large charcoal fire, round which were seated five or six armed Highlanders</i></p> <p>Set at the time of the 1745 Jacobite Rebellion.</p>

<p>Ivanhoe (first published 1820).</p> <p>Accessible on: http://www.gutenberg.org/files/82/82-h/82-h.htm</p>	<p><i>The roof, composed of beams and rafters, had nothing to divide the apartment from the sky excepting the planking and thatch; there was a huge fireplace at either end of the hall, but as the chimneys were constructed in a very clumsy manner, at least as much of the smoke found its way into the apartment as escaped by the proper vent.</i></p> <p><i>There must have been a Norman original of the Scottish metrical romance of Rauf Colziar, in which Charlemagne is introduced as the unknown guest of a charcoal-man.</i></p> <p><i>The Saracens produced from their baskets a quantity of charcoal, a pair of bellows, and a flask of oil.</i></p> <p><i>He [Ivanhoe] had been awakened from his brief slumber by the noise of the battle; and his attendant, who had, at his anxious desire, again placed herself at the window to watch and report to him the fate of the attack, was for some time prevented from observing either, by the increase of the smouldering and stifling vapour. At length the volumes of smoke which rolled into the apartment – the cries for water, which were heard even above the din of the battle made them sensible of the progress of this new danger.</i></p>
<p>Set in the 12th Century.</p>	
<p>The Heart of Mid-Lothian (first published 1818).</p>	<p><i>All hastened around him with their appropriate sources of consolation – the Laird with his purse, Jeanie with burnt feathers and strong waters...</i></p>
<p>Accessible on: http://www.gutenberg.org/ebooks/6944</p>	<p><i>...on occasion of a public meeting at a bonfire in the town of Doune, Rob Roy gave some offence to James Edmondstone of Newton...when Edmondstone compelled MacGregor to quit the town on pain of being thrown by him into the bonfire</i></p>
<p>Set shortly before the Jacobite Rebellion of 1715.</p>	
<p>Rob Roy (first published 1817).</p> <p>Accessible on: http://www.gutenberg.org/files/7025/7025-h/7025-h.htm</p> <p>The Talisman (first published 1825).</p> <p>Accessible on: http://www.gutenberg.org/files/1377/1377-h/1377-h.htm</p>	<p><i>I am he through whom the rays of heavenly grace dart like those of the sun through a burning-glass, concentrating them on other objects, until they kindle and blaze, while the glass itself remains cold and uninfluenced.</i></p> <p><i>Before the cross and altar, in the outward room, a lamp was still burning, a missal was displayed...</i></p> <p><i>But fear not thou to use its virtues [those of wine] in the time of need, for the wise man warms him by the same firebrand with which the madman burneth the tent.</i></p>
<p>Set in the 12th Century.</p>	
<p>Old Mortality (first published 1816).</p> <p>Accessible on: http://www.gutenberg.org/files/6941/6941-h/6941-h.htm</p>	<p><i>That the presbyterians defended themselves stoutly was evident from the heavy smoke, which, illumined by frequent flashes of fire, now eddied along the valley, and hid the contending parties in its sulphureous shade.</i></p> <p><i>Jenny tried cold water, burnt feathers, cutting of laces, and all other remedies usual in hysterical cases, but without any immediate effect.</i></p>
<p>Set in the late 17th Century.</p>	

Marmion (poem first published in 1808). Accessible on: http://www.gutenberg.org/files/5077/5077-h/5077-h.htm	<i>Back to my lonely home retire, And light my lamp, and trim my fire</i> Concerned with the Battle of Flodden (1513).
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With reference to the first quotation from 'Waverley', that heather fires have been referred to in the discussion of the work of Coleridge should be noted, as should the fact that Walter Scott and Robert Burns are believed to have met just the once, in Edinburgh. A turf fire (second quotation) is of course a peat fire. The term coal-black is used in Shakespeare's 'Henry VI Part 3': Scott had probably, in 18th/19th century Scotland, had much more experience of 'coal' than had Shakespeare in his day and circumstances. There is total concurrence between the fourth quotation from 'Waverley' and what was said about subsea coal in three other parts of the present book: discussions of Shakespeare's Henry V and 'Merry Wives of Windsor', and of Defoe's 'Robinson Crusoe'. Charcoal as a fuel features in the next quotation as does pine wood with its characteristic fragrance.

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The matter of smoke exiting a domestic fire by a route other than the intended one via the chimney (first quote from 'Ivanhoe') has featured in the present book in relation to literature set many centuries later than 'Ivanhoe'. The 'planking and thatch' would have made the building very susceptible to fire, and one has the impression that Scott is saying this between the lines. With reference to the following quotes, Scott expects his readers to be aware of the social anomaly whereby the emperor Charlemagne (742–814) was socially linked to a 'charcoal-man'. Charcoal occurs in the next quotation: what was the 'oil'? Probably olive oil, and maybe ill-gotten as Saracen raids on vessels bearing olive oil from Italy as cargo were common at the time in which Scott's novel is set. (It is not being suggested that a *flask* of oil would have been so plundered, but that the flask had been filled from a much larger container which had.) In the next quotation is a statement of the fact that smouldering combustion is productive of smoke, more so than flaming. Anyone having trained in fire protection knows that. It is of interest that Scott describes the movement of the smoke as having 'rolled', and scientific comments can be made on this. It is an instance, like 'radiation enhancement' in the discussion of Mary Robinson's work, of the observation of combustion phenomenology long before any systematised account of it could have been given. In the smoke described as rolling in its advance there are these influences. The hot product gases will tend to rise under buoyancy effects. The smoke is denser than air because of its large proportion of unburnt breakdown products from the fuel, an effect having an opposite effect from the buoyancy referred to. The resultant behaviour is the 'rolling'. The 'stifling vapour' would have been decomposition products not having gone on to burn, responsible for the density effect noted. In the quotation from 'The Heart of Mid-Lothian' there is yet another (one of four or more in the present book) mention of the restorative properties of burnt feathers. 'Rob Roy' and Macgregor are one and the same man, Rob Roy Macgregor (1671–1734) [1]. His reputation was equivocal and that, as recorded in the quotation, he was threatened with immolation (though how seriously this is to be taken is a matter for thought) is evidence of that. The bonfire had been lit in the first place as a festive event.

'The Talisman' is set at the same period as 'Ivanhoe' and both appertain to the crusades. The 'burning-glass' with a succinct account of how it works occurs in the former. By Newton's time or shortly after it the fact that the glass 'remains cold' would have been expressed thus: the glass transmits and reflects but does not absorb solar radiation. The lamp referred to in the second quotation from 'The Talisman' would have been liturgical in purpose and most likely made of beeswax. The third quotation very directly expresses something of supreme importance: that fire can be used for good purposes or for destructive and even lethal ones. This point is noted earlier in the present book when Francis Bacon's 'History of Life and Death' is reviewed. The matter of smoke recurs in 'Old Mortality' and that it flowed as 'eddies' is evidence that the flow had a high degree of turbulence. Burnt feathers, upon which there was clearly such heavy reliance as a revival measure over the period covered by the present book, slip into 'Old Mortality' as shown in the following quotation. Moving on the 'Marmion', to 'trim' a fire is of course to make it suitable for immediate use and enjoyment, perhaps by adding fuel. At the time at which the poem is set the abode, if it had been a modest one, might have had an open fire lacking a chimney structure. It is recorded in [2] that even in the 16th century a newly constructed home might have had only an open fireplace if it was single-storey. More than one storey obviously necessitated a chimney.

References

- [1] <http://www.britannica.com/biography/Rob-Roy>
- [2] <http://www.buildingconservation.com/articles/fireplaces/fireplaces.htm>

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94 Samuel Taylor Coleridge (1772–1834)



Work cited	Quotations
<p>The Raven or A Christmas Tale (written 1798).</p> <p>Accessible on: http://genius.com/2333380/Samuel-taylor-coleridge-the-raven-or-a-christmas-tale-told-by-a-school-boy-to-his-little-brothers-and-sisters-1798/Next-came-a</p>	<p><i>Next came a Raven, that liked not such folly: He belonged, they did say, to the witch Melancholy! Blacker was he than blackest jet,</i></p>
<p>Fire, Famine, and Slaughter (published 1798).</p> <p>'Fire', 'Famine' and 'Slaughter' are personified in this work.</p> <p>Accessible on: http://spenserians.cath.vt.edu/TextRecord.php?action=GET&textsid=35393</p>	<p><i>Hedge and corn-fields all on flame...</i></p> <p><i>The house-stream met the flames, and hiss'd While crash! fell in the roof...</i></p>
<p>The Lime-Tree Bower My Prison (written 1797).</p> <p>Accessible on: http://www.poetryfoundation.org/poem/173248</p>	<p><i>Ye purple heath-flowers! richlier burn, ye clouds!</i></p>
<p>Apologia Pro Vita Sua.</p>	<p><i>In unctuous cones from kindling coal, Or smoke upwreathing from the pipe's trim bole His [a poet's] gifted ken van see Phantoms of sublimity.</i></p>
<p>Frost at Midnight (written 1798).</p>	<p><i>the thin blue flame lies on my low-burn fire, and quivers not; Only that film, which fluttered on the grate Still flutters there, the sole unquiet thing.</i></p>

The point of interest to ‘combustion’ in the first quotation from Coleridge is the reference to ‘jet’. This is a form of lignite, low-rank coal, such as was at much later times to be used in power generation in countries including Germany, the US and Australia. Jet was used in jewellery and ornaments from Roman times, and the deposit of jet near York (‘Eboracum’) was drawn on then. Jet artefacts would have come within Coleridge’s experience by the time he wrote this poem.

Moving on to the highly interesting ‘Fire, Famine, and Slaughter’ the matter of corn fields on fire raises immediately in the mind of a reader the financial loss that that would have entailed⁷⁹. At the time the poem was written there was such a thing as fire insurance which, as recorded elsewhere in this book, came into existence shortly after the Great Fire of London and by Coleridge’s day farms could ensure themselves against loss by fire [1]. In case this is seen as irrelevant let it be noted that ‘Fire, Famine, and Slaughter’ is meant to have a political message. The structural damage in the next quotation would hopefully have had such cover! ‘Heath-flower’, though not exactly synonymous with ‘heather’ to the trained botanist, is approximately so for the purposes of a discussion such as this. ‘Heather fires’ are of course a well documented phenomenon, especially where heather co-exists with pine needles. The term ‘wildfire’ has become broadened sometimes to an extent of being unacceptably vague. However, a heather/pine needle fire accelerated by wind can be seen as an authentic example of ‘wildfire’. In the ‘upwreathing’ smoke in ‘Apologia Pro Vita Sua’ there is an analogy with the ‘rolling smoke’ described by John Milton *q.v.* The reference to pipes can be compared with such references in the work of Henry Fielding and of Aphra Behn.

Combustion behaviour at a domestic coal fire, described in the quotation from ‘Frost at Midnight’, is fairly straightforward to put a present-day interpretation on. In analysis of the work of Thomas Middleton it was conjectured that he had observed within a coal fire the seepage of methane from lumps of coal and a blue flame from that. Coleridge is obviously seeing the same, and the fact that it does not ‘quiver’ is due to the pressure of gas upstream of the flame which gives the flame a structure. Such structure is lacking from parts of the flame due to decomposition of the coal and subsequent ignition of the decomposition products flames from which therefore ‘flutter’. One might want to add the point that with the ‘fluttering flame’ the boundary is not limited by whatever outline is transiently visible. Outside this boundary thermal radiation is being emitted which is outside the visible region, as it also is in the visible part of the flame, *additionally* to the visible component.

Reference

[1] Pearson R. ‘The Development of International Insurance’ Taylor and Francis (2010)

95 Josiah Quincy (1772–1864)



Work cited	Quotations
<p>Memoir of the Life of John Quincy Adams (published 1860).</p> <p>Accessible on: http://www.gutenberg.org/files/20256/20256-h/20256-h.htm</p>	<p><i>These local attachments were indissolubly associated with the events of the American Revolution, and with the patriotic principles instilled by his mother. Standing with her on the summit of Penn's Hill, he heard the cannon booming from the battle of Bunker's Hill, and saw the smoke and flames of burning Charlestown. During the siege of Boston he often climbed the same eminence alone, to watch the shells and rockets thrown by the American army.</i></p> <p><i>A steamer, called the Caroline, owned and fitted out at Buffalo, had been engaged in aiding certain insurgents against the Canadian government with military apparatus and provisions; and an expedition, sent by the British authorities, had cut the Caroline out of the port of Buffalo, set her on fire, and sent her floating over the Niagara Falls. In the fight which occurred one of the men on board the Caroline was killed.</i></p> <p><i>In an oration, delivered in May of this year, before the Massachusetts Charitable Fire Society, Mr. Adams paid a just and feeling tribute to the memory of George Richards Minot...</i></p>

The first quotation contains references to the Battle of Bunker's Hill, the burning of Charlestown and the siege of Boston. There have featured in the discussions herein of the works of the following authors: Hugh Henry Brackenridge, Philip Freneau. The second quotation is but a well-known fact of nineteenth century history, having occurred in 1837. Note that the vessel was a steamer. The incident is mentioned several times in the book under discussion. The 'Massachusetts Charitable Fire Society' [1] was formed in 1792 (when young adults in Massachusetts would have had poignant childhood recollections of the Siege of Boston), and Josiah Quincy was a member. An image of the Caroline at Niagara is shown below as Plate 5.

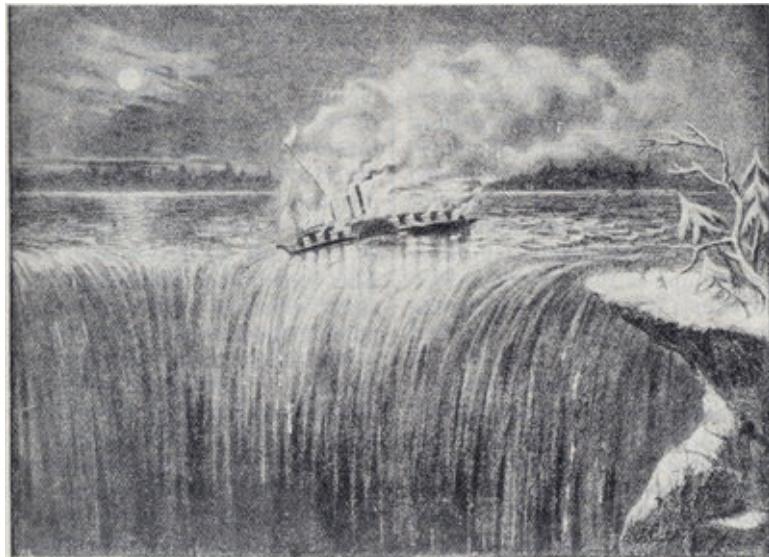


Plate 5. The Caroline at Niagara. Image from:

https://www.google.com.au/search?q=caroline+niagara&biw=1297&bih=691&source=lnms&tbm=isch&sa=X&ved=0ahUKEwjT5ZTs4cPJAhVjraYKHd1IDrQQ_AUBigB#imgrc=ahe711V67X1oxM%3A

Reference

[1] <http://www.proquest.com/products-services/Massachusetts-Charitable-Fire-Society-Papers-291.html>

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96 Robert Southey (1774–1843)



Work cited	Quotations
<p>The Battle of Blenheim a.k.a. After Blenheim (written 1798) [1].</p> <p>Accessible on: http://www.poetry-archive.com/s/ the_battle_of_blenheim.html</p>	<p><i>My father lived at Blenheim then, Yon little stream hard by; They burnt his dwelling to the ground, And he was forced to fly</i></p> <p><i>With fire and sword the country round Was wasted far and wide...</i></p> <p>The Battle of Blenheim⁸⁰ occurred in 1704 so Southey was writing about an event nearly a century earlier.</p>
<p>The Poet's Pilgrimage to Waterloo (first published 1816).</p> <p>Accessible on: http://www.poetryatlas. com/poetry/poem/1024/ poet%26%23039%3Bs-pilgrimage- to-waterloo---brussels.html</p>	<p><i>Her mile-long avenue with lamps was hung, Innumerous, which diffused a light like day</i></p> <p><i>While fiery barges, plying to and fro, Illumined as they moved the liquid glass below.</i></p> <p>The Battle of Waterloo took place in June 1815.</p>

<p>God's Judgment on a Wicked Bishop (first published 1799).</p> <p>Accessible on: http://www.bartleby.com/360/9/11.html</p>	<p><i>Every day the starving poor Crowded around Bishop Hatto's door; For he had a plentiful last-year's store...</i></p> <p><i>At last Bishop Hatto appointed a day To quiet the poor without delay; He bade them to his great barn repair, And they should have food for the winter there...</i></p> <p><i>The poor folks flocked from far and near; The great barn was full as it could hold Of women and children, and young and old...</i></p> <p><i>Then, when he saw it could hold no more, Bishop Hatto he made fast the door... He set fire to the barn, and burnt them all.</i></p> <p><i>...the country is greatly obliged to me For ridding it, in these times forlorn, Of rats that only consume the corn.</i></p>
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Once the Battle of Waterloo was won the scene of it became a place of festivity. Southey was Poet Laureate at the time and gives in his poem a vivid description of that, including the illuminations which were part of the display of rejoicing. In his much earlier poem 'The Battle of Blenheim' he deplores the destruction by fire of peasants' homes. His attitudes to war can be deduced by close comparison of the two poems: all that is required here is a comment that combustion – in one case recreational and in the other destructive – features in both works by Southey quoted from.

It is a fact of history that Bishop Hatto was Bishop of Mentz (Mainz) in the 10th Century, and the legend recounted in 'God's Judgment on a Wicked Bishop' was known to Southey who put it into metrical form.

Reference

[1] <http://www.bartleby.com/270/8/29.html>

97 Jane Austen (1775–1817)



Work cited	Quotations
Sense and Sensibility (first published 1811.) Accessible on: http://www.gutenberg.org/files/161/161-h/161-h.htm	<p><i>...who most needed a provision by any charge on the estate, or by any sale of its valuable woods.</i></p> <p><i>...when dinner was over and they had drawn round the fire...</i></p> <p><i>...glad to be released, after such a journey, from the confinement of a carriage, and ready to enjoy all the luxury of a good fire.</i></p>
Emma (first published 1815). Accessible on: http://www.gutenberg.org/files/158/158-h/158-h.htm	<p><i>'But, Harriet, is it necessary to burn the court-plaster? I have not a word to say for the bit of old pencil, but the court-plaster might be useful.'</i></p> <p><i>'I shall be happier to burn it,' replied Harriet.</i></p>
Pride and Prejudice (first published 1813). Accessible on: http://www.gutenberg.org/files/1342/1342-h/1342-h.htm	<p><i>I can admire you much better as I sit by the fire.</i></p> <p><i>The party then gathered round the fire to hear Lady Catherine determine what weather they were to have on the morrow.</i></p>
Mansfield Park (first published 1814). Accessible on: http://www.gutenberg.org/files/141/141-h/141-h.htm	<p><i>I am sure I told her to bring some coals half an hour ago.</i></p> <p><i>Sir Thomas had been a good deal surprised to find candles burning in his room;</i></p>
Northanger Abbey (published posthumously in 1817). Accessible on: http://www.gutenberg.org/files/121/121-h/121-h.htm	<p><i>We shall not have to explore our way into a hall dimly lighted by the expiring embers of a wood fire...</i></p> <p><i>...and her spirits were immediately assisted by the cheerful blaze of a wood fire.</i></p>

<p>Persuasion (published 1816).</p> <p>Accessible on: http://www.gutenberg.org/ files/105/105-h/105-h.htm</p>	<p><i>The Baronet will never set the Thames on fire, but there seems to be no harm in him...</i></p> <p><i>...the whole completed by a roaring Christmas fire, which seemed determined to be heard, in spite of all the noise of the others.</i></p> <p><i>The breakfast-room chimney smokes a little, I grant you, but it is only when the wind is due north and blows hard, which may not happen three times a winter.</i></p>
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'Sense and Sensibility' is set in Sussex. By the time of the novel there was some production of coke for making iron from its ore but charcoal had not been totally replaced in that role. Charcoal was also needed to make gunpowder, at that time in particular to defeat Napoleon, and the British Navy still used timber vessels. So that the woods on the estate were seen as being 'valuable' is no surprise at all. Whether the homely references to a domestic fire (and there are several other such references in the book) relate to a wood fire or to a coal fire is not clear. The former would have been available for the gathering, but the latter not an extravagance in a wealthy household (cf. the reference to peat fires in Samuel Richardson's 'Pamela' or 'Virtue Rewarded').



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‘Emma’ finds it focus in London. ‘Court-plaster’ is what one would nowadays simply call ‘plaster’, for covering a minor cut or abrasion, though in Austen’s time it also had a cosmetic purpose. Having silk as its base it was easily enough destroyed by burning [1]. Hertfordshire looms large in ‘Pride and Prejudice’ (following row), again within easy trading distance of London. ‘Pride and Prejudice’, like ‘Sense and Sensibility’, gives some emphasis to the domestic fire as the scene of family gatherings and events, and two example are given in the table.

It is clear that at the setting of Mansfield Park coal was being used as a domestic fuel. The term sea-coal, which features in many other parts of the present book, was probably obsolescent by Austen’s time. (The steam engine had been invented by the time Austen became a novelist.) Candles were still the only form of artificial (i.e., other than sunlight) domestic lighting at the time of ‘Mansfield Park’, although outdoor gas lights were very soon to appear in the streets of London. The ‘gas’ for them came of course from retorting coal. A domestic wood fire receives two explicit references in ‘Northanger Abbey’, indicating that wood was sufficiently unusual by then to merit comment. The location was probably inconveniently distant from the coal trading routes of the time. The industrial era was being entered by Austen’s time.

Moving on to ‘Persuasion’, ‘set the Thames on fire’ is a fairly standard figure of speech [2] and means that the baronet is never destined to do anything notable. Presumably the term was restricted to London. Austen was writing at a time when the majority of English men and women were destined to go through life without ever visiting the metropolis. Even about 30 years later when the railway network came into being long-distance excursions were for the privileged only. The next quotation touches on acoustic effects which, in the domestic fire under discussion, would have been caused by an intentional air draft. The problem of smoking chimneys referred to in the final quotation was to be resolved by directional caps. Interestingly, in 1812 – at about the time Austen was writing ‘Persuasion’ – invention of this sort of device was announced [3]⁸¹.

References

- [1] <http://jessica-emmareadingblog.blogspot.com.au/2011/12/court-plaster.html>
- [2] <http://www.usingenglish.com/reference/idioms/set+the+thames+on+fire.html>
- [3] Marsh T. ‘The Monthly Magazine’ 33 (1) p. 553 (1812).

98 Matthew Lewis (1775–1818)



Work cited	Quotations
<p>The Monk (published 1796).</p> <p>Accessible on: https://ebooks.adelaide.edu.au/l/lewis/matthew/monk/</p>	<p><i>It was a small but neat Building: As we drew near it, I rejoiced at observing through the window the blaze of a comfortable fire.</i></p> <p><i>I ascended the staircase. My conductor ushered me into a chamber, where an excellent wood-fire was blazing upon the hearth.</i></p> <p><i>Jacques heard the trampling of our Horses as we rushed by the Barn. He flew to the Door with a burning Torch in his hand, and easily recognised the Fugitives.</i></p> <p><i>She crossed by me, and put a candle into Robert's hand, having received which, He began to ascend the staircase.</i></p>

In the first two quotations the appeal of a fire and its reassuring effect on people are again evident. The setting is Spain, where coal at that time was not in short supply. The scene of its mining was the Asturias; prior to the production of this coal there was import from England. The year of the book was 'late days' for Basque whaling: the hunting by French and Spanish for Whales off Labrador [1]. It had once been a thriving trade and was declining without having stopped altogether by the time of 'The Monk'. That the burning torch referred to used whale oil as fuel is a perfectly reasonable suggestion. In discussing the reference to a candle (and there are several more) in 'The Monk' there is a basis for comparison with the discussion of 'The Talisman' by Sir Walter Scott, written 30 years later than 'The Monk'. In the Spain in which 'The Monk' is set candles for use in churches would have been made of beeswax: that in the quotation was for a strictly secular and utilitarian role and was almost certainly tallow!

99 Edward Augustus Kendall (1776–1842)

Work cited	Quotations
<p>The English Boy at the Cape (first published 1835).</p> <p>Accessible on: https://archive.org/stream/englishboyatcape03kend/englishboyatcape03kend_djvu.txt</p>	<p><i>It [a location in the Cape] grew sterile more and more ; and began to resemble certain coal- countries ; the more so from the black, slaty strata composing its rocks.</i></p> <p><i>...if only to blow the fire, or fetch coal or water.</i></p>

Cape Colony was a British possession by the time Kendall published ‘The English Boy at the Cape’, which is a book directed at children. It is often stated that coal mining in the regions now known as South Africa began in the 1870s, later therefore than the book under consideration. However, coal described in [1] as being of poor quality was discovered in Cape Colony in the first part of the 19th Century, and that might have been what ‘the English boy’ is describing. It is clear from the following quotation that coal of acceptable quality for household use was obtainable in the Cape Province. That some coal was imported to Cape Province from England at that time is known [1].

Reference

[1] Coulson M. ‘The History of Mining: The events, technology and people involved in the industry that forged the modern world’ Harriman House (2012).

100 Francis Scott Key (1779–1843)



Work cited	Quotations
Defence of Fort McHenry (written 1814).	<i>And the rockets' red glare, the bombs bursting in air, Gave proof through the night that our flag was still there</i>

'Defence of Fort McHenry' became of course 'The Star Spangled Banner', being written during and about a battle against the British in Chesapeake Bay which was observed by Francis Scott Key. 'Congreve rockets', invented in England in the early 1800s [1], were used against the Americans in the battle and the 'red glare' he noted was attributable to them. The term 'rocket' is perfectly general, dating from the 17th Century⁸² and meaning something self-propelling over a limited range [2]. Congreve rockets had both explosive and incendiary functions, and the latter provided the illumination by which Francis Scott Key witnessed the events which inspired his poem. The explosive ingredient in the rockets was gunpowder ('the bombs bursting in air') and release of some of the burnt product provided 'red glare' as noted. The Duke of Wellington probably made some input into the decision to use rockets in this war with the US. A 32 lb Congreve rocket is shown below as Plate 6.

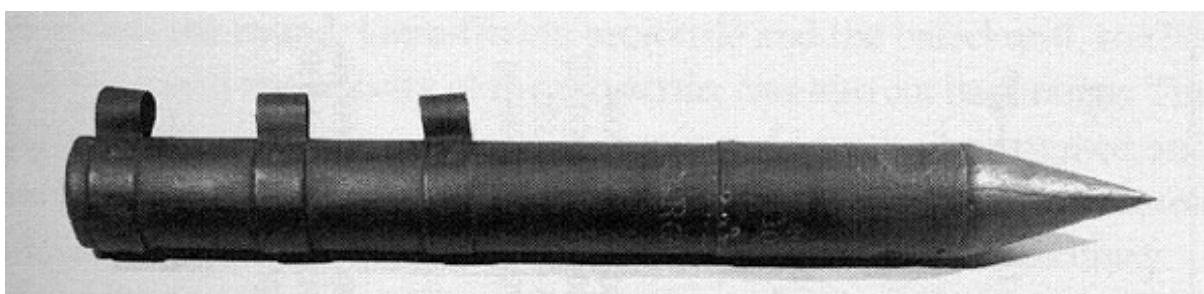


Plate 6. 32 lb Congreve rocket. Image taken from:

https://www.google.com.au/search?q=congreve+rocket&biw=1297&bih=691&source=lnms&tbm=isch&sa=X&sqi=2&ved=0ahUKEwiY_Me94sPJAhXmnqYKHX1SA_AQ_AUBigB&dpr=1#imgrc=SKJUU-Y44S4a5M%3A

A Congreve rocket had the following components: a fuse to provide on impact a detonation which would cause the primary explosive to detonate; a primary explosive containing charcoal and oxidant, and a propellant similar in composition to the explosive. The propellant could carry a 32 lb Congreve rocket about half a mile. Some of the combustion product was released, providing the incendiary function referred to and the 'glare'.

References

- [1] <http://www.spaceline.org/history/2.html>
- [2] <http://www.etymonline.com/index.php?term=rocket>

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101 Frances Trollope (1779–1863)



Work cited	Quotations
<p>Domestic Manners of the Americans (published 1832). Accessible on: http://www.fullbooks.com/ Domestic-Manners-of-the-Americans1.html</p>	<p>From Part 1. <i>Among other sights of desolation which mark this region, condemned of nature, the lurid glare of a burning forest was almost constantly visible after sunset, and when the wind so willed, the smoke arising from it floated in heavy vapour over our heads.</i> ↑ Refers to the Mississippi River near New Orleans.</p> <p>From Part 3. <i>Wheeling has little of beauty to distinguish it, except the ever lovely Ohio, to which we here bid adieu, and a fine bold hill, which rises immediately behind the town. This hill, as well as every other in the neighbourhood, is bored for coal. Their mines are all horizontal. The coal burns well, but with a very black and dirty cinder.</i></p> <p><i>Brownsville [Pennsylvania] is a busy looking little town built upon the banks of this river [the Monongehala river]; it would be pretty, were it not stained by the hue of coal.</i></p> <p><i>At length, however, after shivering and shaking till we were tired of it, and having been half ruined in fire-wood (which, by the way, is nearly as dear [in Cincinnati] as at Paris, and dearer in many parts of the Union), the summer burst upon us...</i></p> <p>From Part 5. <i>This affair at Washington, which in its result was certainly advantageous to America, inasmuch as it caused the present beautiful capitol to be built in the place of the one we burnt, was, nevertheless, considered as a national calamity at the time.</i></p>

<p>The Widow Barnaby (published 1839).</p> <p>Accessible on: http://www.gutenberg.org/files/36563/36563-h/36563-h.htm</p>	<p><i>The evening had all the chilliness of September when its sun is gone; and the small bright fire, with a sofa placed cosily near it, looked cheerily. Wax-lights on the chimney and tea-table, gave light sufficient to shew a large, exceedingly well-fitted up room; and a pretty young woman, neatly dressed, came forward to offer her services in the removal of cloaks and shawls.</i></p> <p><i>When I die, Agnes, if you behave well in the interim, I will bequeath my bees to you, and all the furniture of my two pretty rooms at Compton Basett, as well as all the reserved rents in the shape of allowances, coals, wood, attendance, and the like, which will be mine while I live.</i></p>
<p>The Vicar of Wrexhill (published in 1837).</p> <p>Accessible on: http://www.gutenberg.org/files/36686/36686.txt</p>	<p><i>I have this morning received such a letter from him, in answer to that in which I expressed my wish that he should adopt a profession and prepare to settle himself in life, as wrung my heart. It shall never blast your eyes, my Clara! I watched it consume and burn, and turn to harmless ashes, before I came to cheer and heal my wounded heart by pressing thee to it!</i></p> <p><i>Mrs. Richards had been refused bread by a converted baker; beer, by an elected brewer; and soap and candles, by that pious, pains-taking, prayerful servant of the Lord, Richard White, the tallow-chandler.</i></p>
<p>Paris and the Parisians (published 1835).</p> <p>Accessible on: http://www.gutenberg.org/files/38997/38997-h/38997-h.htm</p>	<p>From Volume 1.</p> <p><i>A few days ago I saw a well-dressed gentleman receive a severe contusion on the head, and the most overwhelming destruction to the neatness of his attire, in consequence of a fall occasioned by his foot getting entangled in the apparatus of a street-working tinker, who had his charcoal fire, bellows, melting-pot, and all other things necessary for carrying on the tinning trade in a small way, spread forth on the pavement of the Rue de Provence.</i></p> <p><i>...the most glorious museums of old carving and gilding, of monstrous chairs, stupendous candlesticks, grotesque timepieces, and ornaments without a name, that can be found in the world.</i></p> <p>From Volume 2.</p> <p><i>...so frequent a practice as they do of inviting either a friend or a mistress to enjoy a tête-à-tête over a pan of charcoal, with doors, windows, and vent-holes of all kinds carefully sealed, to prevent the least possible chance that either should survive?"</i></p>

There is an obvious explanation for the burning forest referred to by Trollope. We are informed in [1] that at that time indigenous Americans used to clear forests by burning to create space for settlements, and that sometimes this operation got out of control. Wheeling is in West Virginia and (in terms of today's travel) quite a short drive from southern Ohio (though clearly Trollope was making that journey in the other direction). There had been coal mining at Wheeling for 25 years by the time of Trollope's visit there [2] and it continued until 1990. Nobody in 1832 could have accepted responsibility for the comment that follows, but if the coal left a 'black and dirty cinder' that is more a reflection on the combustion plant than on the coal. Pennsylvania supplied coking coal at the time of Trollope's visit there (as of course it still does). That firewood was expensive is noted. It was the gathering, packaging and selling that accounted for the price [3]. The next quotation refers to the burning of Washington in 1814, in the relatively recent past at the time of Trollope's narrative.

The most interesting part of the first quotation from ‘The Widow Barnaby’ is the reference to the wax lights, the purpose of which was illumination with attractive holders as an ornamental bonus. It was only something like 30 years after the period under discussion that petroleum wax candles became available. The second quotation from ‘The Widow Barnaby’ can be related to the discussion of ‘The Twa dogs’ by Robert Burns, where it was pointed out that up to as late as 1938 coal in situ at a deposit belonged to whoever owned the land containing the deposit.

Moving on to ‘The Vicar of Wrexhill’, the first quotation has been chosen because the present author has frequently, across the period of literature covered in the book, encountered an incident in which a letter or document is burnt to obliterate irreversibly its contents and this is seen as being almost ritualistic. Tallow candles feature in the next quotation from the book.

Ownership of a charcoal fire by the ‘tinker’ in ‘Paris and the Parisians’ is interesting. Obviously he used it to heat some metal implement like a pan brought to him for repair. It is possible that what Trollope observed was not charcoal but coke (how could she have been expected to know the difference?). Coke had been obtainable in France since 1782 [4] and was abundant there by the time ‘Paris and the Parisians’ was published in 1835. The tinker could probably have laid his hands on enough of that to meet his needs cheaply. We can legitimately speculate a little further. In coke oven operation, the particles of coke too small to be of use in iron making are rejected: the tinker might have had these made available to him at a price well below that of the larger lumps. Coke particle under-sizes became known in the English tongue as ‘coke breeze’. The next quotation from ‘The Vicar of Wrexhill’ is evidence that quality candlesticks were a status symbol at that time. The impression of someone visiting someone’s home for the first time and doing so after daylight would have depended strongly on the attractiveness of the candlesticks. The following quotation appears to relate to the appalling practice of suicide by inhalation of combustion products of charcoal in a sealed room⁸³.

References

- [1] Reeves W.D. ‘Historic Louisiana: An Illustrated History’ HPN Books (2003)
- [2] <http://www.cotf.edu/ete/modules/waterq/wqcoalhist.html>
- [3] Wayne Smith C., Betran J. ‘Corn: Origin, History, Technology, and Production’ John Wiley (2004).
- [4] Berend I., Berend T.I. ‘An Economic History of Nineteenth-Century Europe: Diversity and Industrialization’ Cambridge University Press (2013).
- [5] <https://www.mja.com.au/journal/2012/197/6/carbon-monoxide-induced-death-and-toxicity-charcoal-briquettes>

Concluding remarks

The author was frequently surprised, in his research on the book, to sense ingenuity in combustion matters long before 'combustion science', rooted in physics and chemistry, began. Elegance in contrast to crudity is often apparent in techniques and designs. The distribution of authors across the centuries is as recorded in the table below. The distribution across the centuries is not arbitrary but reflects the volume of published work over the respective periods. Spanning the table Geoffrey Chaucer was the first poet to write in the English vernacular, not in Latin or 'Anglo-Norman'. Daniel Defoe is considered amongst the first (perhaps the very first) novelists. So this book can claim some comprehensiveness.

Century of birth of the author.	Number of authors.
12th	1.
14th	2 .
15th	2.
16th	26.
17th	22.
18th	48.

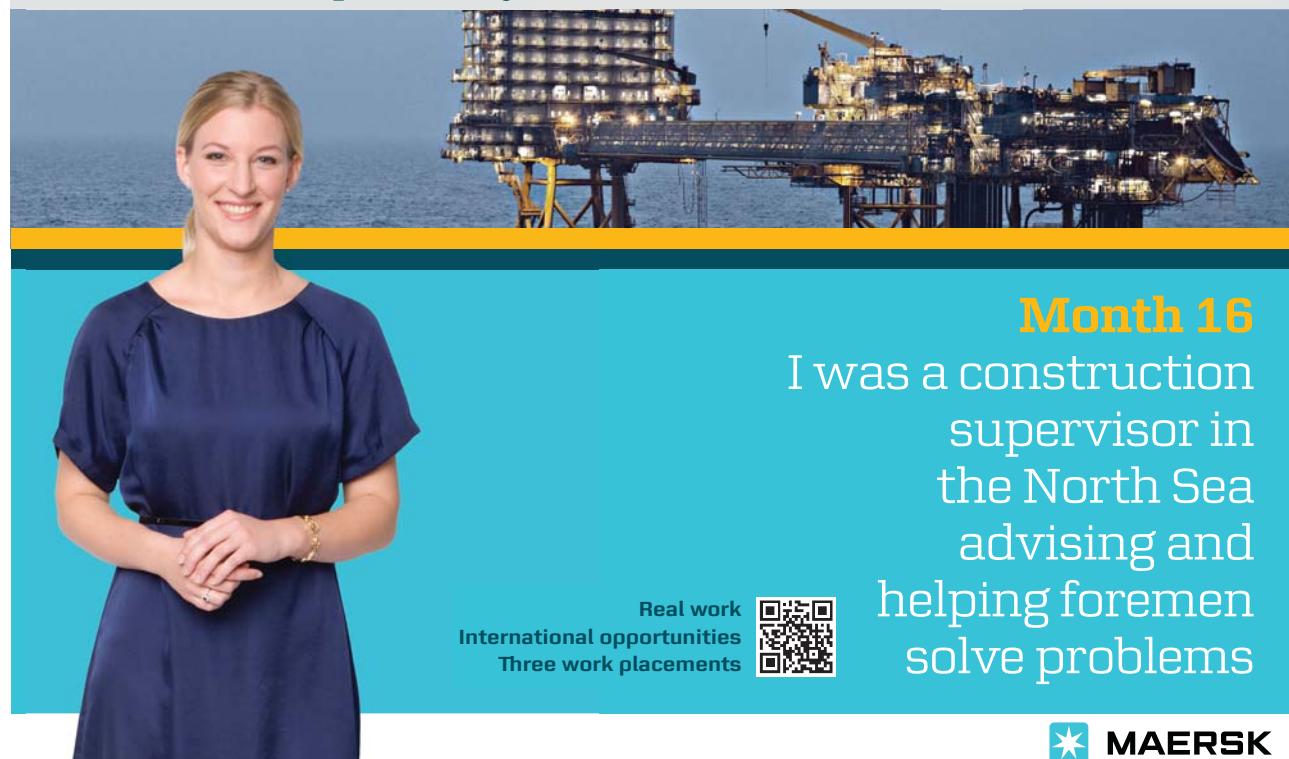
When in December 2014 a talk based on the content of this book was given at Federation University Australia someone made a welcome and pertinent comment relating to something from Dickens. Dickens, who was born in 1812, is for that reason ineligible for inclusion in this book. He died in 1870, one year after J.D. Rockefeller established Standard Oil. There is scope for work combustion details in work by authors like Dickens who belong to the early industrial era. There'd be much more to go on than in the works of, for example, Shakespeare and Chaucer. For someone like Dickens a volume the size of this one might be needed to cover just a small proportion of his work, such was the proliferation of fuels usage and the development of new applications.

Endnotes

1. Offshore oil and gas come of course not from the sea but from geological structures beneath it.
2. There is a return to this point when the work of Shakespeare is discussed.
3. See also the discussion of 'The Pastime of Pleasure' by Stephen Hawes, in which the speed of destruction of straw by fire is used as a figure of speech.
4. See also the coverage of poems by Samuel Taylor Coleridge.
5. There is coal in Kent, but its mining belongs to a much later stage in history and was in any case a commercial failure.
6. This is the definition of a bushel which would have applied at that time. There have been more recent definitions of it.
7. See also the discussion of the work by Françoise de Graffigny.
8. Jane Austen *q.v.* published a poem 'See They Come, Post Haste from Thanet'.
9. No suggestion at all is being made that this relates to the 'Baconian theory of Shakespearean authorship'.

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10. The image of a haystack as an example of spontaneous combustion has carried through to modern times. In a 1983 episode of the English soap opera 'Coronation Street', the character Alf Roberts (played by Brian Moseley) with reference to his singlehood and that of Bet Lynch (played by Julie Goodyear) to whom he is speaking states that they are both 'long past the age of spontaneous combustion'. Bet Lynch replies by saying that she is 'not a flipping haystack'. The setting of 'Coronation Street' is inner city, and it is unlikely that an authentic counterpart of Bet Lynch would ever have seen a haystack in a stable state, let alone one on fire. This is an example of how realities become figures of speech over a period of centuries.
11. It is also referred to in the discussion of Milton's 'Paradise Lost'.
12. There is further reference to this point when Ben Jonson's work is reviewed in a different part of the book.
13. Paper and cotton are both composed of cellulose.
14. There is a return to the meaning of sea-coal in the section on John Donne and in that on Lady Mary Wortley Montagu.
15. Not named the North Sea until very much later than the period under discussion.
16. For more on this see the discussion of 'Robinson Crusoe'
17. Sea-coal in this sense is to be found on beaches along the Gippsland coast in southern Australia, close to where this book is being written.
18. There have been conjectures that he visited Italy.
19. See the section on Sir Thomas Middleton for more on 'spontaneous heating'.
20. This point has been made in numerous sources including <http://tartarus.org/martin/readings/poem08.html>.
21. See also the discussion of 'Memoirs of Miss Sidney Bidulph' by Frances Sheridan.
22. See also the discussion of the work of Sir Walter Scott.
23. See also the discussion of the work of Thomas Campion.
24. See also the discussion of the work of Robert Kerr.
25. Richard III lived from 1452–1485 and reigned from 1483 to 1485. Sir Thomas More (1478–1535) wrote 'Richard III: His Life and Character' in c. 1513, much closer to the events its describes than Shakespeare's 'Richard III' which was written in 1592, and Shakespeare might have drawn on More's work for information. A much later authoritative work on Richard III is: Markham C.R. 'Richard III', first published in 1906. This makes two points of relevance to 'combustion'. One is the use of 'slow matches' for firearms. A 'slow match' is a piece of flax or hemp which remains aglow over a period of hours and can be used to provide ignition as required. It was eventually replaced by the much safer matchstick. The second point is that Richard III 'burnt his ship, resolved to regain his crown or perish in the attempt'. This occurred at the N. Yorkshire coast.
26. See also the discussion of the work of Sir Walter Scott.
27. See also discussion of 'An Essay upon Projects' by Daniel Defoe.
28. See also discussion of 'The Commonwealth of Oceana' by James Harrington, in which fires in such mines are referred to.
29. A present day expert would relate the 'hot fire' to the volatile content of the wood vis-à-vis other sorts of wood.
30. See also the discussion of the work of Olaudah Equiano a.k.a. Gustavus Vassa.
31. At that time. There were variations in the definition later.

32. Veneration of oak trees of great age is evident in one of the late 19th century works of Sir Arthur Conan Doyle.
33. Notably that by the American Howard Pyle in the late 19th century.
34. As a point of 'pedantry', the word 'scientist' was not actually in use in the day of Lomonosov. It was coined much later, in the 1830s, by William Whewell of Trinity College Cambridge.
35. 'Paradise Lost' was published one year after the Great Fire of London.
36. Previously: he was blind by the time he wrote 'Paradise Lost'. His daughters acted as scribes.
37. See also section on Sir John Suckling's work, where a comparison is made with this quotation from 'Paradise Lost'.
38. See also the discussion of 'Hudibras' by Samuel Butler.
39. See also the discussion of the work of Margaret Cavendish.
40. See also the discussion of 'The Age of Reason' by Thomas Paine.
41. Resided in America from 1630.
42. See also the discussion on 'The Nun' by Aphra Behn.
43. See also the discussion of 'The Talisman' by Sir Walter Scott.
44. That in the 18th century clay from Devon was being used to make pipes for smokers, some of them for the export market, is noted in the section of this book on Henry Fielding.
45. See also the discussion of Sheridan's 'The Rivals'.
46. See also the discussion of 'Nature and Art' by Elizabeth Inchbald.
47. Camden is cited in to 'From London the Land's End' though not in this particular connection.
48. Still a dominant practice.
49. See also the discussion of Castle Rackrent by Maria Edgeworth and also the discussion of Jonathan Swift.
50. See also the discussion of 'The Vicar of Wrexhill' by Frances Trollope.
51. Poet Laureate.
52. It is noted in the part of the book on Jonathan Swift that he too referred to 'small coal'
53. A reader wanting a dramatic account of acceleration of burning by movement and consequent oxygen enrichment should read Joseph Conrad's novel 'Youth'.
54. See also the discussion of the work of Robert Kerr.
55. Resided in Japan for his entire life.
56. The year Smollett died.
57. Spelt 'Millenium' by the authoress herself.
58. See also the discussion of 'The Heart of Mid-Lothian' by Sir Walter Scott and that of 'Old Mortality' by the same author.
59. See also the section on John Bunyan.
60. = lantern.
61. At that time a 'go-cart' was a toddler's walking aid [1].
62. Born in Kintyre, Scotland. Died in Pennsylvania.
63. See also the discussion of 'Fire, Famine, and Slaughter' by Samuel Taylor Coleridge.
64. See also the discussion of the work of Josiah Quincy.
65. See also the discussion of the work of Thomas Paine.
66. In very much humbler homes, when metal cans for foodstuffs were first introduced they were sometimes, once emptied of their contents, put into a fire grate to have the same heat economy effect.

67. Not a vessel called Serrano, but one commanded by an officer called Serrano.
68. Vessels from Islamic countries were berthed in that part of India. There were pockets of Islam as far west as Spain by the time of the narrative.
69. The word daub in verb form, meaning to cover a wall with tempered clay, occurs in Shakespeare's 'King Lear'.
70. See also the discussion of the work of Sarah Scott.
71. Interestingly it was during the Gothic period that 'radiate' meaning to 'beam' or to 'shine' entered the English language.
72. See also the discussion of 'The Expedition of Humphry Clinker' by Tobias Smollet.
73. We might note as an aside that this could not be applied to crude oil, which is fluid. That led to the in some ways controversial 'Law of Capture' in places including Texas.
74. This is true in the 21st Century. Towels and cloths from food handling enterprises have after machine washing caused fires during the subsequent tumble drying. Only a very small amount of the contaminant need remain after the washing for this to happen and there have been related insurance claims.
75. The version of 'The History of the Caliph Vathekhe' being drawn on here is a translation from French, as noted.
76. Song of Solomon 3:6; Proverbs 7:17.
77. Resided in the US from 1767.
78. See the discussion of 'Tom Jones' by Henry Fielding.
79. See also the discussion of 'The Vicar of Wakefield' by Oliver Goldsmith.
80. At the time of the Battle of Blenheim the town was called Blindheim.
81. See also the discussion of the work of Alexander Pope.
82. The discussion is of etymology only: 'self-propelling devices' go much further back than that.
83. As recently as 2009 a man in Australia died accidentally when a tray of charcoal which had been used out of doors for cooking was taken indoors as a source of heat. The house was, by design, more enclosed than most because it was under a flight path. The cause of death was carbon monoxide poisoning [5].